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Integration of STEM Education to Humanities: Examining Interdisciplinary Links in Basic Chemistry Course According to Student Views

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Abstract

Science standards for the next generation, as well as other educational reforms, encourage the creation of solid ties between STEM disciplines. Education societies regard integrated STEM as the best practice in various fields. Besides, the integration of disciplines other than STEM has yet to be adequately studied, and the integration of artistic disciplines is limited. Humanist STEM combines the STEM studies in terms of culture, human relationships, level of well-being, and values. This study investigates whether incorporating humanities in an electronic chemistry lecture affects student communication between course themes and interdisciplinary viewpoints. Students were explicitly asked to link STEM subjects between the scientific and the non-scientific, between the scientific and the physical reality from a broader scientific view. This study was conducted with 85 first-year student-teacher candidates studying at the Faculty of Education, Department of Mathematics and Science Education of a Western Black Sea region university in the 2019-2020 academic year. In the study, homework was designed to make evaluations throughout the course. In addition, cross-sectional study analysis was used in the study. A 5-point Likert-type scale was used. All data were analyzed with StatDisk 13 using the required 2 (chi-square) tests. In the data obtained from the research, most students agree that education creates a strong relationship and understanding between science and other undergraduate courses and STEM fields, humanities, and the environment in which they live. This has been observed in traditional (practical) and interdisciplinary (post-implementation) approaches. The findings from this study contribute to the idea of positively altering interdisciplinary perspectives as part of an introductory chemistry course. Today, it is seen that multidisciplinary science is widespread in the fields, and our academic courses need to be shaped according to the specific discipline approaches desired.

Key Words

Basic chemistry course • Multidisciplinary approach • Humanistic and integrated STEM• Science education

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Introduction

In today's world, some problems are waiting to be solved. The interdisciplinary knowledge is needed to understand and solve such issues. In every area, methods for other fields that provide meaning, intellectual research, and multi-perspective analysis are added to concepts. The consistency and harmony of these connections are essential for the information to be balanced (Fogarty, 1991; Trullen et al., 2020). It connects one STEM discipline to another or integrates multiple domains to enhance student learning in the curriculum. A harmonious integration comprises the following disciplinary components: 1) scientific research, in which students create questions and study their own; 2) technical literacy, where students use software, scientific study into which students generate questions and research; 3) design of a systemic problem-solving strategy that adds to the context and offers the ability, throughout the learning process, to use experience and skills, 4) Mathematical thought (English, 2016; Marginson, 2013).

Integration may involve interdisciplinary approaches (seeing one discipline from another's viewpoint) (Bridle et al., 2013), multidisciplinary approaches (exploring a problem from multiple perspectives) (Nguyena & Mougenot, 2022), and interdisciplinary approaches (integrating the knowledge, attitude, and skills of various disciplines with a precise focus) point of views (Ashby & Exter, 2019; Stember, 1991).

Includes a unique, specific, and fascinating background; it focuses on implementation and integration; student-centered approaches and problem-solving through real-world problems; it fosters development of originality and higher-order thinking skills; and it enhances cooperation, and communication skills (Kelley & Knowles, 2016).

Science, technology, engineering, and mathematics educators believe that STEM integration is the most advantageous approach (Sanders, 2012). The STEM disciplines will establish a good relationship between science and other educational reforms in the next century (Haag & Megowan, 2015). Because the integration of curricula creates potential knowledge gaps in faculties (Stinson et al., 2009).

Art is either not evaluated according to learning aims or considered less important. In the studies conducted, this situation was observed in students. (LaJevic, 2013). Although there has recently been a trend toward integrating STEM disciplines and STEM, it has attracted much less attention than integrating the humanities field into STEM (Ortiz-Revilla et al., 2020). A contemporary approach is humanistic STEM, which combines scientific, technological, engineering, and mathematical studies alongside human relations, values, and culture. Just like in STEM disciplines, humanities, and arts disciplines also need basic portable abilities and analytical reasoning patterns such as innovation, context-based viewpoint, intellectuality and inquisitiveness, reason, perseverance, self-reflection, openness to new ideas, and adaptation (Faulconer et al., 2020; Zeidler, 2016). Disciplines within the humanities, such as language, philosophy, and logic, can provide students with different perspectives. For instance, each sentence has a problem-solving approach (Table 1). Students may benefit from using various skills and abilities from multiple fields to learn and practice problem-solving. The integration of STEM, although its effects are not mentioned much in the literature, is seen that students who receive education with an integrated curriculum are more successful than students who study with a divided curriculum (Fan & Yu, 2017). An integrated approach increases the ability to think and solve problems. This is perhaps due to the integration of intellectual, pedagogical, and practical

consequences. (English & King, 2015; Fan & Yu, 2017; Stohlmann et al., 2012). More research must be done to determine the impact of interventions, scaffolding, and teaching designs (Belland et al., 2017; Sanders, 2012). Since attitudes to STEM affect students' motivation (Altakhyneh & Abumusa, 2020), the effect of integration on attitudes and perspectives is essential to understand. This study investigates the influence of small-scale multidisciplinary decomposition in a chemistry course on students' perceptions of the program's commitment to different subjects, programs, and daily life.

Table 1

Compilation of problem-solving abilities from various disciplines (Alkhatip, 2019; Faulconer et al.,2020; Kelly & Knowles, 2016; Nurdyansyah et al., 2017)

Key Ability for Dealing with Challenges	Disciplinary Skill			
	Science	Engineering & Technology	Mathematics	Humanities Meta Discipline
Comprehension of a challenge through…	Observing and inquiring	Defining requirements and restrictions	Creating abstractions about a circumstance, illustrated through icons	Identifying key elements of a problem
Schedule an examination through…	Development and declaration	Evaluate the current solutions	Seeking points of entry for solutions	Challenge beliefs and determine current info
The right instruments…	Strategically	Strategically	Strategically	Strategically
Perform an investigation by…	Systematic experimentation and modeling	Designing and running models	Logic and reason	Organizing information
Iteration towards…	Understanding	A good enough solution	Generalized models and proof	Interpretation
Analyze data…	With logical and quantity-based reasoning	With quantity-based reasoning to find the best layout	With quantity-based reasoning	Searching for a template by combining a mixture of techniques
Build an arguable case out of…	Evidence	Evidence	Evidence	Evidence
Knowledge-driven decisions and backing up…	Overall findings	Design choices	Possible methods of resolution	Possible findings
Communication of…	Ideas, results, explanations, and implications	Ideas, design decisions, and explanations	Potential models	Thoughts, Explanations & Implications
The Job and repute are…	Collective	Collective	Collective	Collective

Therefore, the following research questions were addressed in this study for this purpose:

After this course, can students see a concrete relationship among science, technology, engineering, and mathematics?

After completing this course

-Can students understand the connections or relationships among different scientific disciplines?

-Can students see a concrete relationship between the world and science in their environment after the course?

-Can students see a concrete relationship between science and other lessons after the course?

Method

Research model

A descriptive scanning method was employed in this study. The questions were applied to the students with a 5-point Likert-type scale. Subsequently, both quantitative and qualitative stages were used. Qualitative content analysis was used here due to valid and repetitive inferences in the texts (Krippendorff, 2013; Schreier, 2012). During the content analysis, it was examined by two experts in the field.

Study Sample

This study was conducted with 85 (45 female, 40 male) freshman college student-teacher candidates enrolled in the Colleges of Education, Department of Mathematics and Science Education at a stage university within the boundaries of the western Black Sea during the second term 2019-2020. The ages of the students participating in the study are around 19-20. The screening method was used in the study. The socio-cultural characteristics of the students are close to each other. End-of-course evaluations are provided with data. While the mean return rate of the survey before implementation had been 54.2% from 48 people, the mean return rate of the study after implementation had been 60.2% from 37 people. Demographic data were not collected separately in the course where online distanced education was carried out. Since schools were closed due to COVID-19, the education process continued with distance education. The application was carried out in the compulsory course.

Intervention

A multidisciplinary team worked together to make minor changes to the course that did not affect evaluations, task designs, or prominent points (Table 2). The initial name for the first module is "Chemistry Introduction." For instance, the term "meat and gunpowder" was changed. A quotation by Roger Bacon concerning this relationship between science and maths started with the module overview. Roger Bacon, a British philosopher, is known for his innovative work on gunpowder; therefore, the module's title draws inspiration from his contributions. The module also includes a mathematics video on dimensional analysis for chemistry in the overview. Finally, the module ended with an evaluation study.

The impact of these activities on the expectations of students was assessed by adding final assessment questions. The same questions were asked to the groups before and after the application. Students were requested to respond to

the following claims using the 5-point Likert scale established and arranged by the researcher, Faulconer, Wood, and Griffith (2020).

& The program has established obvious links across STEM disciplines.

& The program has established obvious links between scientific and non-scientific subjects such as literature, history, and the humanities.

& The program has helped me understand science's relationship to the environment surrounding me.

& The program has broadened my understanding of the integration of science to the rest of my undergraduate studies.'

All data has been collected individually without student identification information. Besides, as a different measure of impact, the researcher collected the data from the students' final lecture grades to show that the rich content of the application did not decrease the student's grades. The data were collected after the end of the classes; personal information was removed and evaluated collectively.

Table 2

Built-in STEM integrations

Type of modifications	Explanation of Integration	Extend of Integration
Cross-disciplinary Changes	Human-centered STEM courses	8 Courses (all)
	Include videos of alchemy in debate prompts	2 Courses
	Include citations from scientists with philosophical backgrounds in summaries/abstracts	8 Courses (all)
Interdisciplinary Changes	Attach a video clip explaining the calculations involved in chemistry	1 Course
	Modify the debate prompts to involve engineering as well as technology viewpoints.	3 Courses
	Include a video clip on cross-disciplinary applications of certain chemistry concepts	1 Course

Data Collection Tools and Statistical Analysis

Data were collected online. Beforehand, the students were informed that a survey would be conducted via e-mail. An adaptation of the survey administered to students was made. Reliability and validity studies were carried out by adapting the questionnaire. Cross-sectional study analysis has been used to decide whether the subject links the STEM areas, the humanities, and their surroundings and whether science is related to the rest of the undergraduate programs and to ascertain the expectations of students. The students were unaware of their participation in a research study that avoided any John Henry effect or Hawthorne effect. This effect can be explained in education or training processes as follows: The John Henry effect refers to a situation in which students are motivated to exert more effort when they are in competition with each other in lessons or exams. The Hawthorne effect refers to a situation in which students change their behavior when they are under observation without being aware of it (Irving & Holden, 2013). All data were treated as nominal and analyzed with StatDisk 13 using the necessary 2 (chi-square) test. The responses to the 'Strong Accord' and 'Accept' scales were grouped under the category "I agree," and the answers to the 'Neutral' scale were grouped under the category "Disagreement" and the 'Strongly Disagree' scale. As for all of the four issues concerning science and the learner's understanding of science, a corrected alpha from Bonferroni was used. ($\alpha = .0125$) (Gay et al., 2006).

The final lecture grades of the groups before and after submission were assessed using a special t-test (independent samples).

Findings

Two related Chi-square analyses tested four study questions (Table 3). Chi-square probability tables were used to test the difference in perceptions before and after the application.

Most noticeably, many of the students agree that the training creates a strong correlation and understanding of the relationship of science and other undergraduate courses to STEM fields, humanities, and the environment in which they live. This condition has been observed in both conventional (application) and interdisciplinary (post-application) approaches.

While there is no statistically distinct difference between pretreatment (traditional) and posttreatment (interdisciplinary), constructive intervention is motivating under the first two criteria. STEM discipline connections increased from 72.3% before the application to 85.9% after the application. STEM and humanities association rose from 65.3% to 75.4% after treatment. In this practice, a small-scale, interdisciplinary effect of perspectives was used. A statistically notable shift in students' views was observed here as the courses continued to change to emphasize the humanities. The fact that the real-world commitment is very high, at 88.7%, indicates that a statistically significant effect of the application has little importance.

Final grades were compared between the pre-application mean (65.24) and post-application mean (62.12) groups. Overall results have been analyzed by comparing groups before the application mean (65.24) and after the application average (62.12). Dilutive components did not statistically affect student learning office measured by

recent course grades, and this is a desirable question since minor improvements did not preclude chemistry principles from being learned.

Table 3

Tests of the study (pre-post) tesfreq, chi-square, and sig. values

	Before-Treatment				After-Treatment				Comparing Before-treatment and After-Treatment	
	Approve	Disapprove	$\chi2$	**P**	Approve	Disapprove	$\chi2$	**P**	**P**	$\chi2$
Obvious links among STEM	42 (%87)	6 (13%)	43.687	$<.001*$	34(%91)	3(%9)	26.537	$<.001*$	.897	.295
Obvious links between scientific and non-scientific subject matter and fields like history, art, humanities	35(%72)	13(%28)	28.745	.004*	32(%82)	7(%18)	19.476	$<.001*$	1.673	.349
Obvious links between the surrounding environment and science	43(%89)	5(%11)	44.954	$<.001*$	29(%78)	8(%22)	15.129	$<.001*$	.341	.642
Broadened their perspectives on how science connects to other courses in their degree program	38(%79)	10(%21)	33.329	$<.001*$	33(%87)	5(%13)	25.328	$<.001*$	.294	.785

*** *P values denoted by "*" are significantly important when applying Bonferroni correction (=.0125). The percentage amounts stated are rounded to the closest integer.*

Discussion

The effect of this study should be assessed for some critical limitations. The primary limitation of this survey is the sample group. Rather than conducting a broader analysis of students' impact on such practices, the study focused on ensuring that incorporating interdisciplinary perspectives did not adversely influence students' perceptions. A second limitation pertains to unanswered questionnaires. S ince completing the questionnaire was optional during data collection, it was observed that not the entire sample participated in the survey because they were not encouraged to do so. Volunteer survey responses can introduce bias, leading to a high degree of representation of both positive and negative opinions In survey research, overcoming this limitation is challenging, but it is unlikely to significantly impact the results, given that the questions align with the study's purpose.

Marcone (2022) emphasizes in his study that the cooperation between Social Sciences, Humanities, and STEM education can contribute to achieving Sustainable Development Goals. It has been mentioned that these disciplines come together and participate in producing solutions to social problems and integrating STEM education in social sciences and humanities to achieve sustainable development goals. In their study, Gorbaneva and Shramko (2022) emphasized the importance of developing students' cultural awareness by combining STEM education and Humanities. The aim here is to develop students not only scientific and technical knowledge but also the skills to understand, respect, and interact with people's cultural differences. At the same time, the study explains how students

can integrate cultural content in STEM courses to increase their cultural awareness. Another study emphasized that when data science education is growing, the Humanities can play an essential role in this field. Data science is generally considered a technical discipline that includes extensive data analysis, artificial intelligence, statistics, and programming, while Humanities focuses on people's behavior, culture, history, and social interactions. The study emphasized how Humanities can be included in data science education, why this integration is essential, and that this integration has various benefits. It also highlights that by integrating STEM into the humanities, students can gain broader thinking skills and improve their ability to carry out data science projects more ethically and socially responsibly. Combining Humanities with data science can better equip students in the field of data science and contribute to the understanding of social problems (Vance et al., 2022). Studies in the literature are compatible with our research.

The findings from this study contributed to the idea of positively changing interdisciplinary perspectives as an introduction to a chemistry course. Today, multidisciplinary science is widespread in the fields; our academic courses are not shaped according to the desired particular disciplinary approaches. An interdisciplinary perspective will help our learners to work effectively with people from different backgrounds and disciplines and contribute to understanding the world around them. Our findings are similar to the studies in the literature (Faulconer et al., 2020).

As a result of this study, it was seen that clear connections were established between the students in the courses applied science, technology, engineering, and mathematics. It has been observed how science and non-scientific subjects and subjects such as arts, history, and humanities link to other issues in the undergraduate program within the framework of the world. The connection between this discipline has emerged.

This study's data supported the idea of positively changing interdisciplinary perspectives as an introductory chemistry course. Nowadays, multidisciplinary science is used extensively, but our academic courses must be structured along certain desired disciplinary lines. An interdisciplinary approach would better prepare our students to understand the world and work effectively with people from different backgrounds and disciplines.

Future studies aligned with design-based research will increase the presence of a humanities perspective in the course to see whether more substantial separation can yield statistically significant results. In the following study, validated tools will be used to measure student attitudes (e.g., learning attitudes about science (Adams et al., 2006; Nuhoğlu, 2008), and data collection and evaluation of different course contents are planned.

In line with research focused on design, future studies will increase the involvement of a scientific point of view to see if a more decisive distinction will yield essential statistics. The following research will be based on the validated tools used to test the students' attitudes and the phases of data collection and assessment of different courses (for example, study manners about science.

Various studies can contribute to the existing literature. For instance , humanities can be studied in STEM courses. It can be shaped by student work. Other than that, research on achieving greater collaboration between disciplines and between the Humanities and STEM disciplines may include similar study topics. Studies on the impact of such studies on STEM education and what role the Humanities can play in these reforms can also address a

similar theme.   These research efforts can explore the relationships between STEM education and humanities from the perspectives of students, teachers, and educational policies. Such studies are essential for addressing STEM education with a more comprehensive, multifaceted, and student-centered approach.

Ethic

The ethics committee's approval of the research data should be stated. (12.10.2020, 3-19, Kastamonu University)

Author Contributions

The author carried out all processes of the article (Introduction, Method, Results, and Conclusion).

Conflict of Interest

The author declares that they have no conflict of interest.

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How Do We Perceive The Phenomenon of "Co-Parenting"? Do We Share Responsibilities Sufficiently?: A Bibliometric Study

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Abstract

The primary objective of this study is to assess co-parenting research through bibliometric analysis. The documents under evaluation were sourced from the Web of Science (WoS) database. Initially, 473 studies were were retrieved using keyword "co-parenting". Subsequently, after applying exclusion criteria, a comprehensive bibliometric and content analysis was conducted on the remaining 421 articles. These studies were classified and visually represented based on their characteristics. It was determined that the studies evaluated within the scope of the study were conducted between 1981 and 2023. The analysis revealed that the author with the highest number of publications was O. Cohen and the most productive institution was "University of Toronto". Co-parenting, divorce, parenting, and fathers emerged as the most frequently recurring keywords through co-keyword analysis. Furthermore, the study titled "The internal structure and ecological context of co-parenting: A framework for research and intervention" was identified as the most cited study through co-reference analysis. The study concludes that Paul R. Amato was the most influential author in the co-citation analysis, while Marsha Kline Pruett was the most influential author in the co-author analysis.

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Introduction

The phenomenon of co-parenting, characterized by its multidimensional and different dynamics, addresses the relationship between primary caregivers, typically mothers and fathers, within the context of their parental roles. The earliest known study on this concept (Ernst & Altis, 1981) explicates the principles of co-parenting, emphasizing the need for equal participation, shared responsibility, and cooperation, especially following divorce. This phenomenon, which gained popularity in the 2000s, has been the determining factor in the family roles of couples committed to maintaining family integrity. Therefore, the perspective that this concept constitutes a significant element within the family system has gradually gained acceptance over time, leading to a notable surge in both descriptive and experimental studies on the subject. The evidence presented by the studies shows that the concept of co-parenting has an impact on children, relationships between spouses and parental behaviors (Katz & Low, 2004; Li et al., 2020; McLanahan & Beck, 2010; L. Ren et al., 2020; Sznitman et al., 2019). In this regard, it is of immense value to assess the current state of research concerning the co-parenting phenomenon and to formulate prognostications for the future. Such an evaluation is possible by examining the relevant documents in the literature.

When analyzing studies on the concept of co-parenting in Turkey, it becomes evident that the number of studies on this subject is rather limited. Notably, there have been recent studies conducted with married couples (Özdemir et al., 2020a; Özdemir et al., 2020b; Özdemir & Sağkal, 2020c; Özdemir et al., 2021; Salman-Engin et al., 2018; Salman-Engin et al., 2019), but research involving divorced parents (Erdemir-Aşıkoğlu, 2022) remains scarce. When examining empirical and review studies on this concept in the international literature (Amato, 2005; Carneiro et al., 2017; Francia et al., 2019; Jaffe et al., 2008; Molla-Cusi et al., 2020; Nunes et al., 2021; Xiao & Loke, 2021), it is apparent that these publications are both older and more numerous compared to those in Turkey. Additionally, it has been observed that various perspectives have been employed to understand the concept. In order to increase the number of studies on the concept of co-parenting in Turkey, where the subject is evaluated in a narrow framework, it is considered extremely important to examine the international literature and identify the gaps and unevaluated aspects of the subject. It is thought that the guidance provided by the documents analyzed by bibliometric analysis (providing concrete data on qualities such as keywords and productivity) will make a significant contribution.

Bibliometric analysis encompasses methods that allow the evaluation of cumulative publications on the subject based on specific criteria. It is an ideal method to identify researchers, groups, publications, countries as well as institutions' contribution to the relevant field, subject or concept. It saves time and prevents researchers from getting lost in piles of data. In this way, researchers can explore their field of study by seeing the most effective studies instead of reading the entire literature (Öztürk & Kurutkan, 2020). The bibliometric analysis method has become more preferable because the global problems have changed the study habits of researchers, the masses of information and the ways of obtaining information have changed with the spread of digital technologies and it provides more concrete data compared to other compilations.

When the studies conducted with this analysis method in Turkey were examined (Akın & Kurutkan, 2021; Ekşi et al., 2022; Gülmez et al., 2021; Gürsoy & Çolak, 2023; Kemeç & Yalçın, 2022; Kurutkan et al., 2021; Köse et al., 2020; Köse & Kurutkan, 2021; Öntürk-Akyüz & Dilmen-Kalı, 2023; Özteke-Kozan, 2020; Turhan & Türkoğlu,

2023; Yücel et al., 2023), it was found that bibliometric analysis was used in different disciplines. However, when the studies conducted specifically in the field of early childhood education and parent education were examined, it was seen that the studies were very limited (Çelik, 2022a; Çelik 2022b; B. Ergin & Ergin, 2022a; B. Ergin & Ergin, 2022b; E. Ergin et al., 2022; E. Ergin et al., 2023; Güney & Baran, 2022; İnaltekin & Karaçöp, 2020; Yanık-Özger, 2022). Although the concept of co-parenting has a history dating back to the 1980s, the fact that it has only recently been addressed in Turkey has led us to examine the relevant literature. Therefore, it is considered meaningful to conduct the current study in order to fill this gap in the field. In this context, the study contributes to the field by evaluating the general view of the research on co-parenting through content analysis and bibliometric analysis methods. The research questions evaluated within the scope of the study are as follows:

1. What is the distribution of the descriptive qualities of the relevant publications?

2. What does the co-author, co-word, co-reference and co-citation network look like?

Method

In this study, studies on the concept of "co-parenting" in the Web of Science database were examined using bibliometric analysis method.

Procedure

In determining the sources to be evaluated within the scope of the study, a selection was made according to the inclusion criteria. These are; 1. To be in the Web of Science database, 2. To be about the concept of "co-parenting", 3. To be a research article. Since a specific topic was focused on in the preparation of the data set of the relevant study, a search was made with the keyword "co-parenting" and then the relevant sources were identified through detailed examinations. The data set was prepared by applying the inclusion criteria in August-2023. The use of inclusion-exclusion criteria and purposive sampling helped to ensure the external validity of the study. All data of the research were kept in electronic environment in order to ensure the confirmability of the study. In addition, all processes for obtaining the data to be used in the study were defined in detail such as date, concept, code, database. Using the code TS= ("co-parenting"), 473 studies were reached by searching the topic category without applying any other restrictions (index, citation, language, year, etc.). The number decreased to 421 when only research articles were identified. All of these studies were considered to meet the criteria. In this sense, the fact that the conditions for meeting the criteria of a small number of unrelated data, which are thought to have no effect on the results, were not examined one by one can be expressed as a limitation regarding the preparation of the data set.

Data Analysis

Descriptive analyses of the obtained resources were conducted out using WoS's own system, while bibliometric analyses and visual mapping were carried out with the VOSviewer 1.6.15 software. The bibliographic information from the 421 sources obtained from WoS was transferred to the VOS-viewer program. In order to prevent possible errors, the obtained "tab-limited file" was reviewed and unnecessary data was cleaned.

Results

In the study, as a result of the search in the WoS database with the keyword "co-parenting", 421 research articles written on the subject between 1981-2023 were reached and evaluated within the scope of the study. The findings of the evaluations are presented under two main headings as descriptive findings and bibliometric findings.

Descriptive Findings

When the distribution of the number of articles of the relevant publications according to years was analyzed, it was seen that the publications from 1981 to 2003 progressed with a certain increase while there was a great increase after 2003. It was determined that there was an increase in the number of studies on the subject especially between 2012 and 2023. While 17 publications were produced on the subject before 2003, the year in which the most publications were produced was 2022. While 30 to 60 publications were regularly produced every year between 2019-2023, it was determined that at least 10 or more publications were regularly produced every year after 2012 (Figure 1).
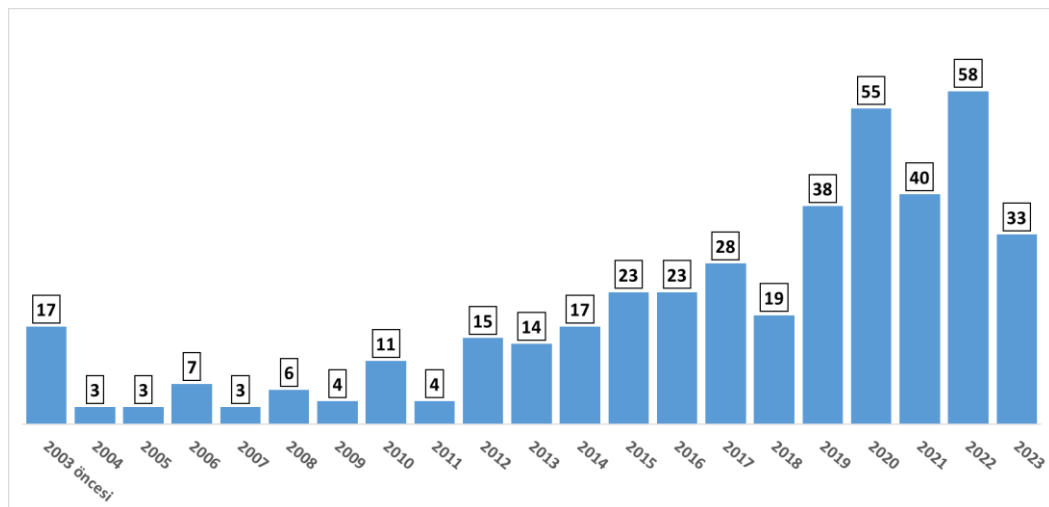
Figure 1. Distribution of studies by years

When the distribution of the number of articles according to the publishing institutions in which the relevant studies were published was examined, it was seen that there were 50 or more publications produced within the scope of the subject in journals affiliated with Wiley, Taylor & Francis, Springer publishing institutions. Then, it was seen that Elsevier, SAGE Publications, American Psychological Association, Frontiers Media SA publishing institutions include 10 or more publications produced within the scope of the subject. Multidisciplinary Digital Publishing Institute (MDPI), Oxford University Press, BMC, Emerald Publishing are also among the top 10 publishers that publish the most on the subject (Table 1).

Table 1

Distribution and number of citations of studies by institutions with the highest number of publications

Publishing institutions	Number of articles (f)	Number of citations (cc)
Wiley	96	4479
Taylor & Francis	69	3722
Springer	52	3154
Elsevier	38	2354
SAGE Publications	37	2039
American Psychological Association	36	483
Frontiers Media SA	16	1043
Multidisciplinary Digital Publishing Institute (MDPI)	9	536
Oxford University Press	9	416
Emerald Publishing	3	169
BMC	3	106

Bibliometric Findings

When the distribution of the number of articles according to the institutions where the authors of the relevant publications work was analyzed, it was determined that the most productive institution was "University of Toronto". This was followed by "The Pennsylvania State University". Although The Pennsylvania State University ranked second in terms of the number of articles, it was the most cited institution among the top ten institutions. This can be explained by the high number of publications in journals with high impact value. Therefore, the effectiveness of the institution in terms of citation, that is, the indicators of its efficiency and visibility, were revealed. These institutions were followed by The University of Queensland, The University of Melbourne, University of Wisconsin, Newcastle University, Tel Aviv University, La Trobe University, University of Illinois Urbana, University of Denver. It was determined that the institutions were from different countries (Table 2).

Table 2

Distribution of studies by the universities with the highest number of publications

Publishing institutions	Number of articles (f)	Number of citations (cc)	Total connection strength (tcs)
University of Toronto	12	174	6
The Pennsylvania State University	11	499	3
The University of Queensland	8	128	5
The University of Melbourne	8	122	15
University of Wisconsin	8	114	3
Newcastle University	8	42	4
Tel Aviv University	7	187	4
La Trobe University	7	103	7
University of Illinois Urbana	6	159	2
University of Denver	6	73	4

When the map showing the distribution of the number of articles of the relevant studies according to countries is examined, it is seen that the highest number of publications on the subject is in the United States of America (f=192; cc:3340; tcs:37). It is followed by Australia (f=46; cc:548; tcs:14), China (f=31; cc:244; tcs:11), Canada (f=28; cc:407; tcs:10), England (f=26; cc:266; tcs:18), Spain (f=24; cc: 107; tcs:6), Italy (f=15; cc:138; tcs:6), Israel (f=14; cc:235; tcs:2), Germany (f=10; cc:30; tcs:4) and the Netherlands (f=10; cc:147; tcs:4) (Figure 2).
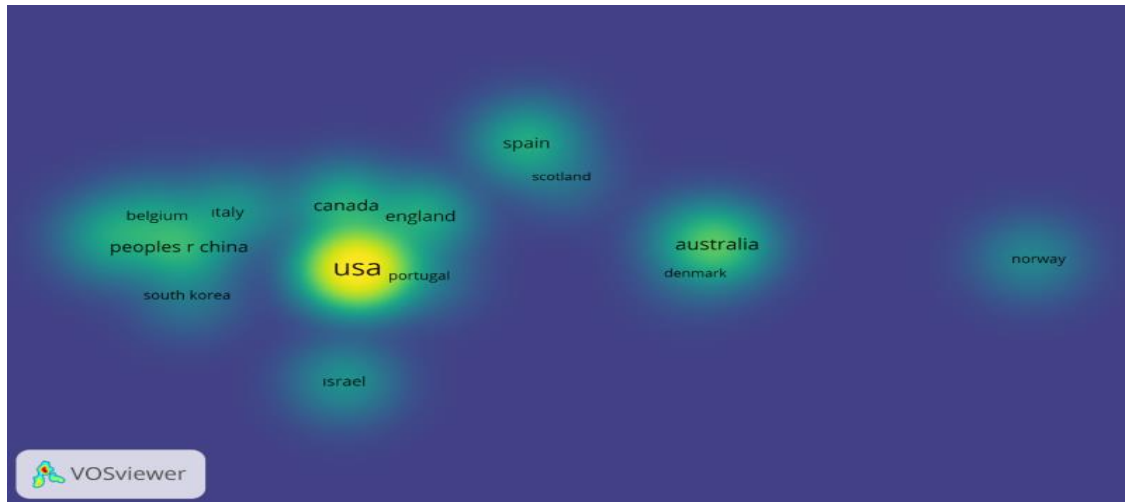
Figure 2. Visual mapping of countries of publication

The number of citations for the 10 most referenced studies on the subject is provided Table 3. In the studies, it is seen that the effect of co-parenting experiences of convicted fathers on their children's educational outcomes, the context of violence between spouses and child custody, the impact of intergenerational cultural transmission on children's creativity skills, the effect of anger problem seen in men during postnatal processes on family functioning and relationship, the effect of co-parenting behaviors on family internet addiction, the relationship of co-parenting behaviours with marital satisfaction, and the co-parenting behaviors of parents whose children were diagnosed with autism were examined (Table 3).

Table 3

The 10 most cited articles

	Article	Number of citations (cc)
1	McLeod, B. A., Johnson Jr, W. E., Cryer-Coupet, Q. R., & Mincy, R. B. (2019). Examining the longitudinal effects of paternal incarceration and co-parenting relationships on sons' educational outcomes: A mediation analysis. *Children and Youth Services Review, 100*, 362-375.	184
2	Austin, W. G., & Drozd, L. M. (2012). Intimate partner violence and child custody evaluation, Part I: Theoretical framework, forensic model, and assessment issues. *Journal of Child Custody, 9*(4), 250-309.	173
3	Culley, L., Hudson, N., & Lohan, M. (2013). Where are all the men? The marginalization of men in social scientific research on infertility. *Reproductive biomedicine online, 27*(3), 225-235.	147
4	Pang, W., Lu, Y., Long, H., Wang, Q., & Lin, L. (2020). Three-generational families: Are they beneficial to Chinese children's creativity?. *Thinking Skills and Creativity, 35*, 100623.	139
5	McKay, T. (2023). When state violence comes home: from criminal legal system exposure to intimate partner violence in a time of mass incarceration. *Journal of interpersonal violence, 38*(3-4), 2683-2715.	136
6	Trahan, M. H., Morley, R. H., & Shafer, K. (2021). Father-adolescent relationship closeness: A path analysis of family factor associates with father-adolescent engagement and relationship quality. *Child and Adolescent Social Work Journal, 38*, 265-282.	132
7	Macdonald, J. A., Greenwood, C. J., Francis, L. M., Harrison, T. R., Graeme, L. G., Youssef, G. J., ... & Olsson, C. A. (2020). Profiles of depressive symptoms and anger in men: associations with postpartum family functioning. *Frontiers in psychiatry, 11*, 578114.	126
8	Sun, Y. (2023). The role of family on internet addiction: A model analysis of co-parenting effect. *Cogent Social Sciences, 9*(1), 2163530.	120
9	Antunes, N., Vieira-Santos, S., Roberto, M. S., Francisco, R., Pedro, M. F., & Ribeiro, M. T. (2021). Portuguese Version of the Kansas Marital Satisfaction Scale: Preliminary Psychometric Properties. *Marriage & Family Review, 57*(7), 647-672.	118
10	Saini, M., Stoddart, K. P., Gibson, M., Morris, R., Barrett, D., Muskat, B., ... & Zwaigenbaum, L. (2015). Couple relationships among parents of children and adolescents with autism spectrum disorder: Findings from a scoping review of the literature. *Research in Autism Spectrum Disorders, 17*, 142-157.	115

It was determined that Orna Cohen (f=5; cc:28; tcs:3) was the most prolific author with five studies on "Co-parenting". While Orna Cohen authored one individual study titled "Agreement reached through court mediation conducted by social workers: Impact on the co-parenting relationship", she collaborated with other authors in her other four studies (Cohen, 2012; Cohen & Levin, 2012; Cohen & Finzi-Dottan, 2013; Cohen, Finzi-Dottan & Tangir-Dotan, 2014; Finzi-Dottan & Cohen, 2014). She is followed by Marsha Kline Pruett (f=4; cc:75; tcs:3) with four studies and the highest number of citations. The structural model for the collaboration between the authors is given in Figure 3. When visual mapping is examined, it is seen that author connections form two groups within themselves.

While the most active author in the first group is Marsha Kline Pruett, the most active author in the second group is William G. Austin (f=3; cc:52; tcs:2) (Figure 3). When the study areas of the authors in the figure are examined, it is seen that Pruett focuses on family conflicts, parenting practices, divorced couples, while Austin focuses on parental care, child custody, violence between spouses and parenting plan. Drozd has studies on parental coordination, divorce, family law, parent-child communication problems and child sexual abuse, while Fieldstone has studies on family law, experimental-based family plans and elderly care coordination. It is seen that McIntosh's fields of study are developmental psychology, parenting, childhood traumas, children under foster care and parental deprivation.
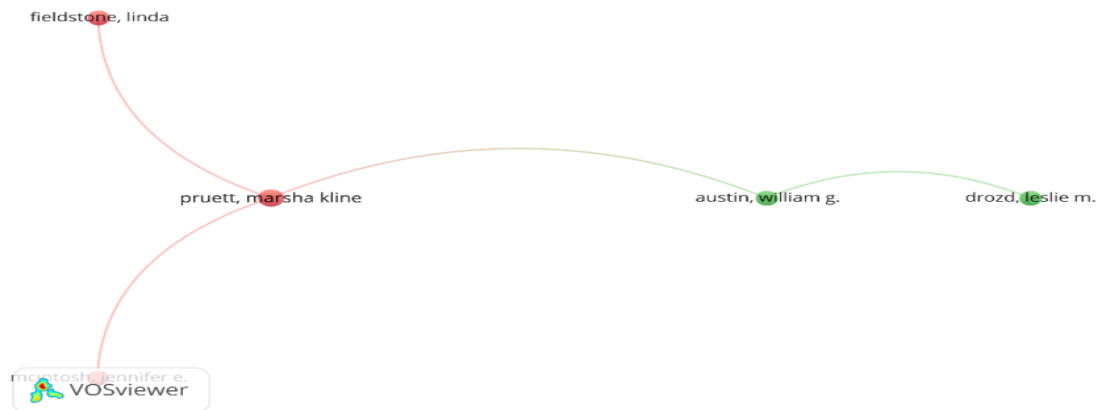
Figure 3. Co-author analysis network map

When the results of the co-word analysis of the studies on co-parenting in the Web of Science database are examined, it is seen that four clusters are formed in the figure. The red cluster includes the concepts of co-parenting, parenting, fathers, fahter involvement, parenting stress. The green cluster includes the concepts of divorce, parenting coordination, separation, while the blue cluster includes children and domestic violence. Finally, the yellow cluster includes the concepts of gender and fatherhood. In this sense, according to the results of common word analysis, the most frequently used words are co-parenting (f= 143; tcs:92), divorce (f= 53; tcs:55), parenting (f= 40; tcs:30) and fathers (f= 26; tcs:19) (Figure 4). These concepts are followed by other concepts (domestic violence, father involvement, parenting coordination, fatherhood, separation, children, co-parenting, gender, parenting stress) with a frequency of ten or more repetitions.
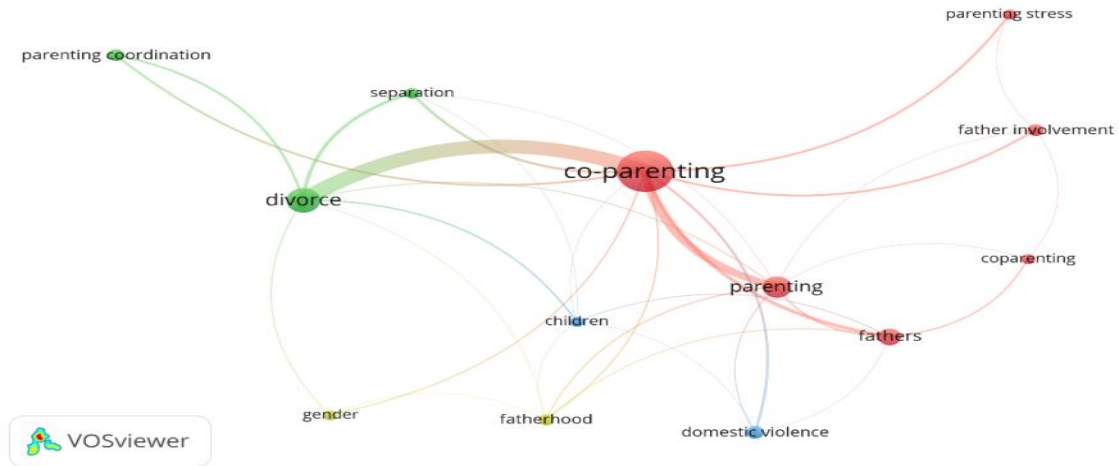
Figure 4. Co-word analysis network map

When the results of co-reference analysis of studies on co-parenting in the Web of Science database are examined, it is observed that there are clusters that interact with each other. The relationships in the analysis are expressed with colors on the network map. As a result of the analysis, it is seen that four clusters are formed in the figure. Total connection strength (tcs) expresses the relationship between elements depending on their positioning. Close positioning indicates a higher relationship, while distant positioning indicates less or no relationship. It is seen that the most cited study titled "The internal structure and ecological context of co-parenting: A framework for research and intervention" is by Feinberg (2003) (cc;80; tcs:143). The other three most cited studies are by Feinberg et al. (cc:44; tcs:77; 2012), Teubert & Pinquart (cc:37; tcs:80; 2010), Margolin et al. (cc:35; tcs:69; 2001), respectively (Figure 5).
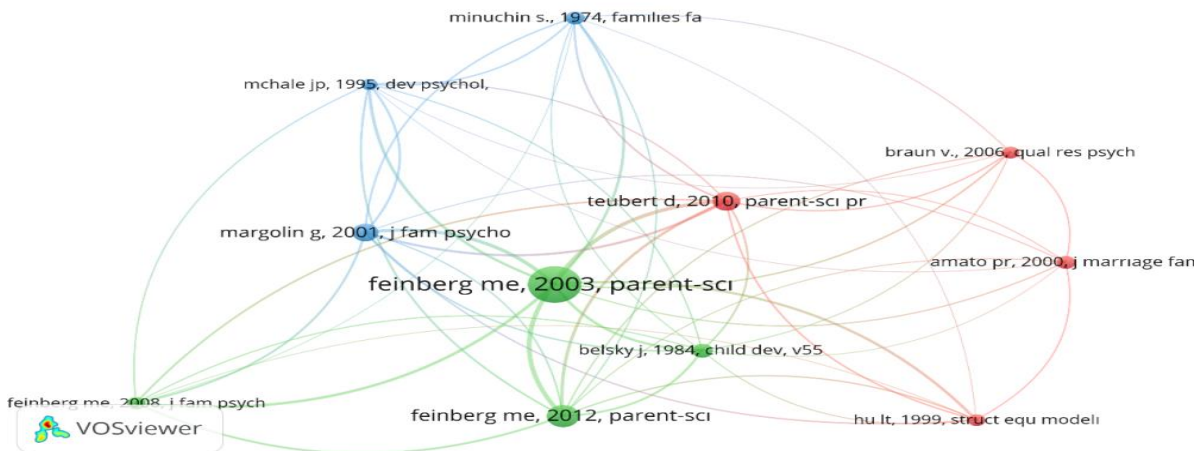
Figure 5. Co-reference analysis network map

When the results of the co-citation analysis of the studies on co-parenting in the Web of Science database are examined, it is observed that the relationship between the cited authors is clustered in different colors. The most

frequently cited author in studies on co-parenting is Paul R. Amato with 403 citations and 8 total connection strength. The authors with 140 or more citations are Ruth Feldman, Jason Pribilsky, Peter G. Jaffe and Juan F. Linares, respectively. The authors with 8 or more total connection strength are Tamara A. Fackrell, Peter G. Jaffe, David G. Schramm, Armon R. Perry, respectively. It is concluded that the authors who stand out in the nodes in the figure have both high citation numbers and high total connection strength (Figure 6).
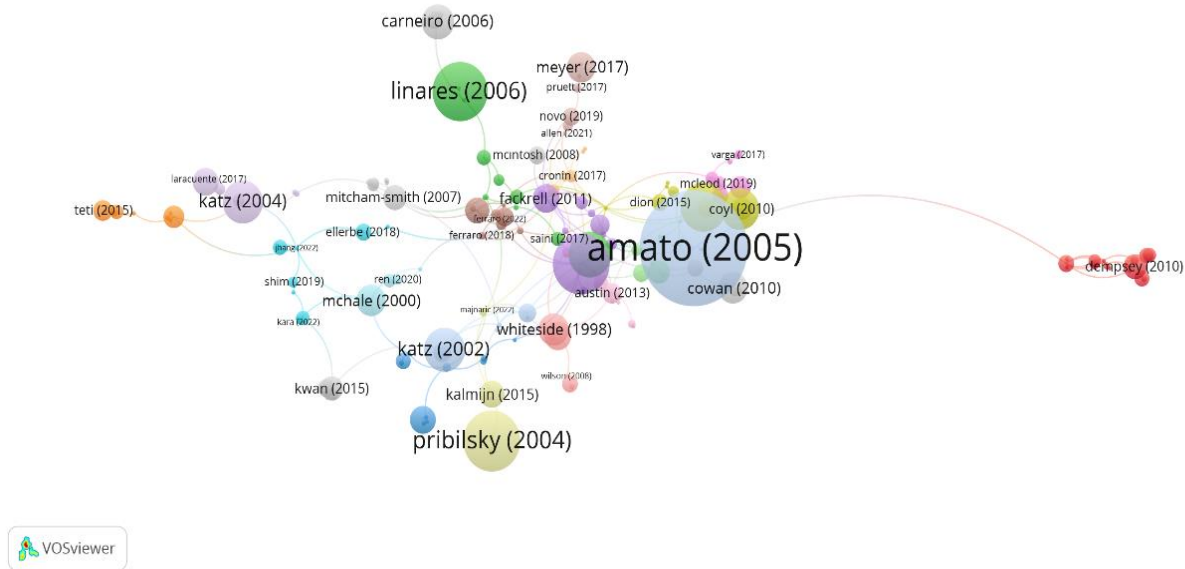
Figure 6. Co-citation analysis network map

Discussion and Conclusion

In the study, the WoS database was searched with the keyword "co-parenting" and the sources accessed were evaluated using content analysis and bibliometric analysis methods. The study included an examination of how the phenomenon of "co-parenting" is defined in the literature, its scope, and its context related to the concepts with which it is associated were included in the study.

When analyzing 421 research articles on the phenomenon of "co-parenting" in the WoS database, it was found that these studies studies conducted between 1981 and 2023. The research findings reveal a significant increase in the number of studies on the subject, especially in the last five years. It is thought that the view that father involvement is effective in child rearing process and child development, which has been emphasized more in recent years, and the studies in the literature based on this view support this result (J. Ren et al., 2020). In addition, in family-related studies, it was determined that it is important for both parents to share parenting roles and that it is necessary for them to participate effectively in decision-making processes related to children (Salman-Engin et al., 2019). Therefore, co-parenting emerges as a concept that supports the development of today's parenting styles. Moreover, the fact that the majority of the studies on the subject are published in quality publishing institutions such

as Wiley, Taylor & Francis, Springer, Elsevier, SAGE Publications and that these articles are the most cited studies in the relevant subject shows that researchers and those studying in the field are curious and interested in the phenomenon of co-parenting.

When evaluating the institutions with the highest number of studies on the phenomenon of co-parenting, it was concluded that the University of Toronto ranked first. The Pennsylvania State University was identified as the second university with the highest number of publications. However, when the citation ranking was analyzed, it was seen that The Pennsylvania State University ranked first. When an analysis is made according to this result, it is thought that the publications of the authors working at The Pennsylvania State University are more visible or that their studies on the phenomenon explain it with a multidimensional and broader perspective.

When the studies focusing on the phenomenon of co-parenting were analyzed in terms of the country with the highest number of publications, it was seen that the USA ranked first. This was followed by Australia. When the past family dynamics of America and European countries were examined, it was shown that the factor underlying juvenile delinquency was the decrease in family affection due to the weakening of family ties (Şener, 1996). In addition, when the family cultures in America were analyzed, it was seen that the responsibility of the child until puberty was within the limits of love and physical care of the mother with the support of the father (Kağıtçıbaşı, 2000). In line with this information, it is possible to talk about the existence of the phenomenon of co-parenting with the support of parents in the child-rearing processes in the United States. The concept of co-parenting encompasses the joint participation of spouses in the child-rearing process, which is the most basic function of the parenting role, and the strengthening of marital harmony. Therefore, it is thought that the joint participation of parents in child-rearing processes depending on their well-being levels will increase family well-being in strengthening the deteriorated family dynamics in the United States and other countries (Peltz et al., 2018). Based on this idea, there has been an increase in the number of studies on the related phenomenon.

When the top ten most cited studies among the sources evaluated within the scope of the study were examined, it was seen that the first study with the highest number of citations examined the effect of the co-parenting experiences of the spouses on the educational processes of their children during the period when the father was imprisoned (McLeod et al., 2019). This study emphasizes that parents should be encouraged to apply parenting strategies that can minimize conflicts and make decisions in consensus starting from early childhood in order to ensure co-parenting, and underlines the importance of developing early intervention policies for this purpose. In other studies, co-parenting phenomenon is evaluated in the contexts of violence between spouses and child custody (Austin & Drozd, 2012), the effect of anger problems seen in fathers in the postpartum period on family functions (Culley et al., 2013), the effect of intergenerational cultural transmission on children's creativity skills (Pang et al., 2020), father-adolescent relationship (Trahan et al., 2021), and the effect of internet addiction on co-parenting behaviors (Sun, 2023). In terms of scope, these studies are in line with the distribution of studies focusing on the co-parenting phenomenon according to years. Because when the phenomenon of co-parenting was first discussed, it emphasized the legal processes of divorced or separated parents in their parenting journey and child welfare in this process. The studies conducted at that time also addressed the concept within this framework. However, today, this phenomenon

refers to the joint decisions of spouses on child rearing and their joint participation in child rearing processes. In particular, the prominence of the concept of father involvement in studies emphasizes the role of the father in co-parenting.

Orna Cohen was found to be the most prolific author with five studies on the phenomenon evaluated within the scope of the study. In his study, Cohen (2012) emphasizes that if parents in the divorce process benefit from the mediation system, conflicts between individuals will decrease and children will not be affected by this process. The concept of mediation is a legal process that enables the parties to find a solution themselves in case of disagreement. In this respect, the mediation system offered to families includes premarital agreements, separation, divorce, financial disputes in the family, alimony, parenting planning (custody, visiting order), parent-child conflicts (Wikipedia, 2023). Divorce process, which is accepted as the birth point of the co-parenting phenomenon, has become a concept evaluated together with the mediation system over time.

When the results of the co-author analysis of the studies focusing on the phenomenon of co-parenting are analyzed, two groups are formed in the figure. In one of these groups, Marsha Kline Pruett emerges as the most effective author, while in the other group, William G. Austin takes on the most effective author. According to the figure, Drozd is the author with whom Austin formed a co-authorship network. When the studies of the authors on the subject were analyzed, it was found that the studies on spousal violence in child custody (Austin & Drozd, 2012), child custody during divorce and intimate partner violence (Austin & Drozd, 2012) were addressed. When the studies of Pruett, another author with the highest connection strength, were examined, it was seen that the reflection of narcissistic personality disorder and empathetic disposition on parenting skills (Mandarino et al., 2016), parental conflicts and parent-child relationship in the context of parental guarding behaviors (Austin et al., 2013), the effect of parental involvement on children's attachment styles in divorced families (Pruett et al., 2014) were discussed. It is seen that the studies were conducted based on the divorce process which is the starting point of the definition of co-parenting. When the studies conducted between 2012-2017 in the focus of the related phenomenon were analyzed in general framework, it was determined that the concept of co-parenting is mostly related to parents who were divorced, in the process of divorce or living separately.

When the co-word analysis of the studies focusing on the phenomenon of co-parenting were examined, it was determined that the words associated with "co-parenting" formed four clusters. It was concluded that the concepts of co-parenting, parenting, fathers, father involvement, parenting stress were related to each other in the red cluster. The concepts of divorce, parenting coordination, separation were related to each other in the green cluster while children and domestic violence were related to each other in the blue cluster. Finally, the concepts of gender and fatherhood were related to each other in the yellow cluster. When evaluated in terms of frequency of connection, it was concluded that the concept of co-parenting was more related to the concepts of divorce, parenting and fathers. According to the findings of the study, the concept of co-parenting entered the literature in the 1980s, but it was discussed in studies on families that maintain family integrity in the 1990s. This can be explained by understanding that the father's influence in parenting roles cannot be ignored due to the increasing emphasis on gender equality in societies and by emphasizing that parenting is a whole. Therefore, the concept of "co-parenting" has been updated in

this way (Cabrera et al., 2000). Early studies on the concept focused on the necessity for divorced parents or the parents in the divorce process to cooperate in their parenting roles. Today, studies mostly explain the parenting roles and responsibilities of parents living together (McHale et al., 2004). However, in the literature, the phenomenon of "co-parenting" does not only refer to parents who are divorced or whose marriage bond continues, it also includes the grandparents in the decision-making processes in the upbringing of the child. At this point, the important thing in the phenomenon of co-parenting is that there are two parents responsible for upbringing the child and they are involved in the child-rearing process by taking joint responsibility (Özdemir & Sağkal, 2020c). From this point of view, associating the concept of "co-parenting" with concepts such as divorce, fatherhood role, separation, father involvement reveals the main line of the literature. In addition, the prominence of father involvement in the concepts of co-parenting can be explained by the significant increase in studies on father involvement after 2017 according to the results obtained from the WoS database.

When the results of co-reference analysis of studies focusing on co-parenting were examined, it was concluded that the most cited source was the study of Feinberg (2003). In this study, Feinberg provided detailed information about the conceptualization process of co-parenting. He also discussed the mediating variables of the concept by explaining the effect of parental harmony on parent-child in the co-parenting process. Other studies with high connection strength as a result of co-reference analysis are the study on the psychometric information and measurement of the "Co-parenting Relationship Scale" developed by Feinberg et al. (2012), the meta-analysis study conducted by Teubert & Pinquart (2010) on co-parenting and child adjustment, and the study by Margolin et al. (2001) in which co-parenting is theoretically and conceptually separate from other concepts related to parenting and the mediating role of concepts such as conflict and cooperation between spouses is examined. It is seen that the most cited studies and the studies that guide other studies are those that have a good conceptual background in general. In addition, these studies address other concepts that are considered to be effective in establishing the framework of the concept. This result indicates that the history of the concept in the literature is old, but not many studies have been conducted on the subject.

When the results of co-citation analysis of studies focusing on co-parenting were evaluated, it was determined that the author with the highest number of citations was Paul R. Amato. In his study, Amato (2005) discussed how changing family dynamics will affect the cognitive, social and emotional well-being of the next generation. It was concluded that this study is the source with the highest connection strength and number of citations on the subject. Another study is by Jaffe et al. (2008) on domestic violence which emphasizes the need to develop appropriate parenting plans for child and family well-being. When the results of the study are examined from this aspect, it shows that the phenomenon of "co-parenting" is related to the harmony and determination of the parents in the decisions they take by considering the best interests of the child. In addition, studies have tried to determine the theoretical and conceptual framework of co-parenting by addressing the supportive aspect of co-parenting and the harmony between spouses. Today, the empathic tendency and cooperation observed between spouses, regardless of being divorced or together, is accepted as an indicator of co-parenting. In the light of these results, the study is valuable in terms of reaching comprehensive results of the studies conducted on the co-parenting phenomenon in the literature.

Limitations and Recommendations

This study includes the research articles on "co-parenting" in WoS. In this sense, not using other databases can be considered as a limitation of the study. However, WoS is considered as a reliable data source. In similar studies, it is frequently preferred like Scopus. Different databases may be used in future studies. In addition, more verifiable results may be obtained by applying the index constraint. In this study, content analysis and bibliometric analysis were conducted. In future studies, different software that can evaluate the same qualities may be preferred. In addition, the same concept may be analyzed with different methods. Focusing on only one subject in the study is considered as an important limitation in the creation of the data set. Therefore, general concepts that can generate larger data sets may be preferred. In the study, the concept of co-parenting was analyzed and discussed in the context of the relevant literature.

Ethic

The research does not require ethics committee approval.

Author Contributions

The design, material preparation, data collection and analysis, final reading and approval of the study belong to the author.

Conflict of Interest

There is no conflict of interest for the study.

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Opinions of Mathematics Teachers about Mathematics Literacy Proficiency Level Table

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Abstract

The aim of this study is to determine the opinions of mathematics teachers about the mathematical literacy proficiency level table and their knowledge about the proficiency levels. In line with the purpose of the research, case study was used as a method. In the sample of the study, there are 201 mathematics teachers working in various secondary and high schools in 56 provinces across Türkiye. The data collection instruments employed in this study encompassed a demographic information questionnaire, a proficiency level opinion form, and proficiency level determination questions. Of the educators who actively engaged in this research, 103 individuals were identified as male participants, while the remaining 98 were designated as female participants. 179 of them work in public schools and 22 of them work in private schools. Again, the working years of the teachers who mainly participated in the research are between 6 and 10 years. These teachers mainly teach 11th graders and work in Anatolian high schools. As a result of the findings obtained from the research, it is seen that although the teachers found the proficiency level table to be understandable in general, they emphasized the need to explain through more examples. In addition, when the teachers asked them to level the questions according to the proficiency level table, it was seen that they could not accurately level the questions according to the table. The research was concluded by giving suggestions to the people who will do similiar ones in this field.

Key Words

Mathematical literacy • Mathematics teacher • Proficiency level table

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Introduction

When literacy is mentioned, basic skills such as reading and writing come to mind first (Özgen & Kutluca, 2013). Turkish Language Association [TLA] (1998) defines literacy as the state of being literate. For society, literacy is being able to read any printed material (newspaper, book, magazine, etc.) (Yore, Pimm & Tuan, 2007). The concept of literacy has assumed a paramount significance across diverse academic disciplines. Proficiency in a given field implies the capacity to adeptly navigate the contextual landscape, discern emerging challenges, possess the requisite literacy competencies to access and appraise information for informed decision-making, locate repositories of pertinent knowledge, and facilitate the seamless utilization of technology (Çapar & Gürdal, 2001). In today's society, efforts are made to raise individuals who can think more creatively and quickly, and who have learned how to access information by increasing in an incremental manner, with an approach that emphasizes personal differences (Umay, 2004). In order to raise individuals in this way, individuals must be literate.

Although it is thought that the concept of literacy emerged with the Programme for International Student Assessment (PISA) implemented by the Organisation for Economic Co-operation and Development (OECD) (Bozkurt, 2019), the truth of the matter is not like this. It is thought that the concept of literacy first and mainly became one of the teaching goals towards the end of the 19th century and emerged due to the order of the changing world with the evolution of the industrial society towards the information society (Yenilmez & Ata, 2013).

Like many other concepts, the concept of literacy has also become specialized in the process, and as one of these specializations, mathematical literacy has taken its place in the literature. The prominence of the mathematical literacy concept has arisen concomitant with the growing disjunction between the mathematical curricula taught in educational settings and its practical applicability in real-life contexts. Indeed, were it not for the somewhat unexpected misalignment between the primary objectives of mathematics and the pedagogical methods employed in its instruction, the emergence of the notion of mathematical literacy would have remained less likely (Altun, 2020). For this reason, the old understanding of mathematics, which was perceived as the use of abstract concepts and the skills to use abstract concepts together, has been replaced by a new understanding of mathematics (Altun, 2020), which includes real-life models, where the person can make sense of and solve the problems he/she encounters, and which has constantly developing skills in this process (De Corte, 2004). When the literature is examined based on this information, it has been seen that different definitions of mathematical literacy have been made. Some of these definitions are as follows:

● Mathematical literacy is one's capacity to formulate, use and interpret mathematics in multiple contexts and contexts. Mathematical literacy is to be able to define existing events, to explain events and to make predictions about events, to reason mathematically and to include mathematical concepts, process steps, verified information and using these tools. Mathematical literacy plays a pivotal role in fostering an enhanced awareness among individuals regarding the multifaceted role that mathematics assumes within the global landscape. Furthermore, it empowers individuals to exercise discernment and make well-informed judgments and decisions, constituting fundamental prerequisites for citizens characterized by their constructive, discerning, and reflective attributes (Organisation for Economic Co-operation and Development [OECD], 2013a).

● Mathematical literacy is not just about dealing with formal mathematics, which is considered high-level, it's about making mathematics understandable for all people, where everyone can engage and use it as an empowering tool. It includes mathematical and non-mathematics situations in daily life (McCrone & Dossey, 2007).

● Mathematical literacy is the competent use of knowledge and skills related to mathematics. The competence mentioned here is the ability to make sense of a problem in which mathematics plays a leading role, to feel the need for mathematics while making the final decision, and to use mathematics related to the aforementioned things correctly (Altun, 2020).

Mathematics plays a very important role in today's world. Mathematics is used as a tool to provide solutions to problems faced by the individual in the real world (Lengnink, 2005). Mathematics and daily life are inseparable. Being mathematically literate is important for life, as mathematics enables students to develop solution methods and thought systems related to problems that are likely to be encountered in daily life (Şefik & Dost, 2016). In addition, it is widely accepted that mathematical literacy is important in a career in any science (Vila & Sanz, 2013). The fact that literacy has become a priority issue in many countries' innovations in education is due to PISA, which is implemented by the OECD and applied in a wide geography (Kabael & Barak, 2016).

PISA uses the term "literacy" to describe the broad focus on the use of knowledge and skills (Institute of Education Sciences [IES], 2010). Over the past decade, the terminology "mathematical literacy" has prominently featured within the discourse of reform literature in the realm of mathematics education. However, it is noteworthy that there exists a conspicuous absence of precise and universally accepted definitions elucidating the parameters of this term (Amit & Fried, 2002).

There is a perception that the term mathematical literacy has emerged with the PISA applications of the OECD (Bozkurt, 2019). However, before mathematical literacy was defined by the OECD, mathematical literacy was presented as one of the visions of mathematics education by the National Council of Teacher of Mathematics (NCTM) in 1989 (Sari & Wijaya, 2017). Mathematical literacy, as delineated by the NCTM commission, is characterized by mathematical proficiency that possesses the functional capacity to be applied across diverse contexts and under varying conditions (Soytürk, 2011). The concept of literacy, which is used by PISA to cover some broad competences dealing with adult life (Anderson, Lin, Treagust, Ross & Yore, 2007), is the ability to use and analyze knowledge and skills in interpreting and solving the problems that students encounter in many situations in the main subject areas, related to the competencies of making logical inferences and communicating effectively (Ministry of National Education [MoNE], 2010b). These identified competences are based on situations where they can be applied and have meaning in the lives of adults who have no special connection with the curriculum of the participating countries. Evaluations focus on students' ability to apply their knowledge and skills to real-life problems and situations (Anderson et al., 2007). Due to the needs in daily life, the term "literacy" has entered the education system of many countries and has become one of the main goals of these education systems (Bekdemir & Duran, 2012). Mathematical literacy, as expounded by Bansilal, Mkhwanazi, and Mahlabela (2012) and subsequently reinforced by Korkmaz (2016), denotes the orientation of an individual's life trajectory through the integration of mathematical applications into their daily existence, with a profound interconnectedness to real-life

contexts. What is aimed in mathematical literacy is not for students to do more mathematics, but for them to make more applications and to use mathematics to make sense of the world while doing these applications (Bansilal et al., 2012).

The OECD, which was established in 1961 and was formed by the gathering of 34 countries, including Türkiye, is concerned with education policies as well as economic policies. The reason for this is that education and economy are directly related to each other (Akgündüz, 2018). PISA, which was established by the OECD to determine the success levels of students, started its first studies in 1997 and in 2000, the actual application was made and the literacy levels were evaluated in accordance with an international standard (Aksu, 2019; Anderson, Chiu & Yore, 2010; Chung, 2013). OECD applies the PISA assessment exam in order to obtain education-related data (Akgündüz, 2018). PISA, as noted by Aşkar and Olkun (2005), Karabay, Yıldırım, and Güler (2015), and affirmed by the OECD (2019a), serves as a global assessment tool designed to gauge the proficiency levels of students aged between 15 years 3 months and 16 years 2 months, who have completed a minimum of six years of formal education. Its primary purpose is to ascertain the extent to which these students have acquired foundational knowledge and skills requisite for active engagement in societal and economic spheres, as well as to assess their overall preparedness for the challenges of life ahead. In this exam, each term is evaluated by focusing on a type of literacy such as reading skills, mathematics and science literacy. These levels repeat themselves in every three-year period. The cycle that started in 2000 ended in 2006 and a new cycle started in 2009 (Birbiri, 2014; MoNE, 2010b; OECD, 2014a). Türkiye participated in these exams for the first time in 2003 (Eraslan, 2009; MoNE, 2005). 41 countries, 30 of which were OECD countries, took the exam in 2003. Türkiye ranked 36th among all countries and 28th among OECD countries. 57 countries, 30 of which were OECD countries, participated in the exam in 2006, and Türkiye's place among all countries was 43rd and 29th among OECD countries. In the year 2009, a total of 65 nations, with 33 among them belonging to the OECD consortium, engaged in the examination. In this assessment, Türkiye secured a ranking of 44th on a global scale and occupied the 32nd position within the subset of OECD member countries. Similarly, in the subsequent year of 2012, the examination witnessed the participation of 65 countries, with 34 counted as OECD member states. Türkiye's performance in this iteration also resulted in a global ranking of 44th, while within the OECD context, it held the 31st position. In 2015, 72 countries, 35 of which were OECD countries, took the exam and Türkiye ranked 50th among all countries and 34th among OECD countries. In 2018, 79 countries, 37 of which were OECD countries, participated in the exam and Türkiye ranked 42nd among all countries and 33rd among OECD countries (MoNE, 2005; 2010a; 2010b; 2015a; 2016; 2019). Türkiye showed a performance close to the bottom ranks among OECD countries, and close to the middle ranks in all participating countries. According to PISA reports, it is seen that Türkiye is not a very successful country in the field of mathematical literacy (Bozkurt, 2019). In addition, PISA determines the success status of the countries in line with the answers given by the students to the questions. These success situations are also decided according to their proficiency levels. Conversely, proficiency levels serve the dual purpose of establishing the complexity gradients of posed inquiries and delineating a structured framework for ascertaining students' mathematical literacy proficiencies and competencies (Altun, 2020).

PISA is widely recognized as crucial in the development process of determining proficiency levels (Suna, Tanberkan & Özer, 2020). It is a scale developed by PISA administrators, based on students' responses to questions

in past and future exams, for the purpose of summarizing the data obtained (Kamaliyah, Zulkardi & Darmawijoyo, 2013). OECD has defined seven proficiency levels for mathematical literacy. The descriptions of these levels by OECD are presented in Table 1.

Table 1

Mathematical Proficiency Levels Table

Level	Characteristics of Tasks
6	At Level 6, students can conceptualise, generalize and utilize information based on their inverstigations and modelling complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations together and flexibly translate amongst them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for attacking novel situations. Students at this level can reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments and the appropriateness of these to the original situation.
5	At Level 5, students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insight pertaining to these situations. Studenst at this level habe begun to develop the ability to reflect on their work and to communicate conclusions and interpretations in written form.
4	At Level 4, students can work effectively with explicit models for complex, concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. Students at this level can utilize their limited range of skills and can reason with some insight in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	At Level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources amd reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional

relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.

2   At Level 2, students can interpret and recognize situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures or conventions to solve problems involving whole nımbers. They are capable of making literal interpretations of results.

1   At Level 1, students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

0   At Level 0, students may have skills such as reading a number in a very clearly stated simple representation and performing some very simple operations with natural numbers.

Retrieved from (MoNE, 2013; OECD, 2019b)

However, as also noted by Altun (2020), the level descriptions provided in the level table do not align with the levels of the questions. Therefore, there is a need to identify the issues experienced by mathematics teachers, who are users of the mathematical literacy proficiency level table, regarding this table. There are many studies in the literature on the level of mathematical literacy proficiency (Aydoğdu-İskenderoğlu & Baki, 2011; Seis, 2011; Aydoğdu-İskenderoğlu, Erkan, &Free, 2013; Karataş, 2019; Retnawati & Wulandari, 2019; Şaban, 2019; Yiğit, 2019; Yıldırım, 2019; Öztürk & Masal, 2020; Sarıkaya, 2022; Şahin, 2022). However, studies containing opinions on the proficiency level table are quite limited (Calp & Kalkan, 2022; Selçuk & Tezbaşaran, 2022). Typically, these investigations are oriented towards the assessment of question complexity found within educational materials, including textbooks and national standardized examinations, or towards the evaluation of students' proficiency levels. That's why, the aim of this study is to determine the opinions of mathematics teachers about the mathematical literacy proficiency level table and their knowledge about the proficiency levels. For this purpose, the problems of the research are:

●   What are the opinions of secondary and high school mathematics teachers about the proficiency level table?

●   What is the knowledge of secondary and high school mathematics teachers about the proficiency levels of mathematical literacy questions?

Method

In this study, case study, one of the qualitative research methods, was used. Case study is a research method frequently used in the social sciences (Heale & Twycross, 2018). A case study research is a qualitative approach in which the researcher gains detailed and in-depth knowledge by using multiple sources of information about real-life situations and various bounded systems, describing a case or revealing case themes (Creswell, 2013). The utilization

of a case study approach serves as a valuable means to elucidate comprehensive and insightful explanatory insights pertaining to the specific subject of inquiry (Kaleli-Yılmaz, 2019). In the case study "How?", "Why?" and what?" questions are sought (Çepni, 2018). In this research, a case study research method is employed because the aim is to uncover the opinions and knowledge of mathematics teachers regarding the mathematical literacy proficiency level table.

Research Sample

Teachers working in 56 provinces and different types of schools in Türkiye were asked to estimate the level of the questions in the mathematical literacy test according to the mathematical literacy proficiency level table. 201 secondary and high school mathematics teachers working throughout Türkiye participated in the research. Although the range determined by PISA as the age group coincides with the high school level, it was important to get the opinions of the teachers working in secondary schools. Given that the Ministry of National Education (MoNE) oversees the participation of secondary school students in the PISA examination (MoNE, 2019), and concurrently, secondary school mathematics educators assume a pivotal role during the transitional phase from secondary to high school, this confluence of factors underscores their collective significance within the educational milieu. For these reasons, secondary school mathematics teachers, another group likely to use the proficiency level table, were also included in the sample of this study. Mathematics teachers participated in the research in 103 male (51%), 98 female (49%). 179 (89%) of the teachers who participated in the research work in public schools and 22 (11%) in private schools. When the working years of the participating teachers in the profession are examined, 30 teachers from 0-5 years participated in 15%, 56 teachers from 6-10 years in 28%, 45 teachers from 11-15 years in 22%, 30 teachers from 16-20 years in 15%, 20 teachers from 21-25 years in 10%, 26 -14 teachers from 30 years in 7%, 3 teachers from 31-35 years in 1.5%, 1 teacher from 36-40 years in 0.5%, 1 from 41-45 years in 0.5% and 1 teacher in 46-50 years in 0.5%. Out of the teachers participating in the research, 28 of them work in middle schools, 151 in high schools, and 22 in both types of schools. It is seen that teachers who have worked in the profession for a maximum of 6-10 years participated in the research. In addition to these, it is noteworthy that the teachers participating in the research mainly teach 11th grade students and they work in Anatolian high schools.

Data Collection Tools

Within the scope of this research, 3 data collection tools were used. Details of the data collection tools used are presented below.

Demographic information questionnaire: This questionnaire was applied to find out the gender of the teachers participating in the study, the types of their institutions, types of their schools, the grade levels they teach, the years of work in the profession and the province they work in. Thanks to this survey, it will be possible to draw a general profile of the teachers participating in the study.

Proficiency levels opinion form: As stated by Altun (2020), there are areas in the proficiency table that are not understood. For this reason, an opinion form was created in order to determine the problems experienced by the teachers in the mathematical literacy table. This created opinion form was shown to 2 mathematics educators who

are experts in their field. With the arrangements made in line with the opinions received from the experts, the opinion form was made ready for application. According to the opinions of the experts, the points that the teachers were asked to pay attention to in the table were added as explanations to the side of the questions.

Questions for determining proficiency levels: To assess the precision of teachers' ability to forecast question difficulty levels utilizing the mathematical literacy table, a 7-question instrument was devised, drawing upon mathematical literacy inquiries expounded by PISA, encompassing one representative question from each proficiency level. This form was shown to 2 mathematics educators who are experts in their field. With the arrangements made through the opinions of the experts, the form was made ready for application. With the opinions of the experts, an option has been added so that the teachers can decide more easily on the levels to be given to the questions.

In Table 2, the questions asked to mathematics teachers and the proficiency levels provided by PISA for these questions are presented. The questions used were selected from the questions released by the OECD's PISA assessment.

Table 2

Asked Questions and Their Proficiency Levels

Category	Level	Question
Low	Level 0	Which Car?
Low	Level 1	Charts
Low	Level 2	Staircase
Intermediate	Level 3	Internet Relay Chat
Intermediate	Level 4	Coloured Candies
High	Level 5	Test Scores
High	Level 6	Carpenter

Retreived from (OECD, 2006; OECD, 2013b; Bezek-Güre, Kayri & Erdoğan, 2020; Sönmez, 2022)

Data Analysis

Within the scope of the research, a mathematics literacy proficiency level table was given to the mathematics teacher working in various secondary schools and high schools, and the teachers were expected to level the questions according to this table, and at the same time, the teachers' opinions about the table were taken. Following the systematic elimination of erroneous data entries, a total of 201 datasets remained for comprehensive evaluation.

Teachers were systematically assigned unique codes ranging from A1 to A201, and their corresponding comments were subsequently rendered in a coded format for presentation and analysis. First of all, the demographic data obtained from the teachers were examined and tabulated. As the next step, the levels given by the teachers to the mathematical literacy questions were examined with a frequency table. In the last step, teachers' views on the proficiency level table were tabulated and examined. Content analysis has been used for organizing the views of mathematics teachers about the mathematical literacy proficiency level table. Content analysis was used in the analysis of such qualitative findings. The main purpose of content analysis is to guide the academic studies aimed to be carried out in the content of the subject discussed and afterwards, and to determine the general trend related to the subject examined (Ültay, Akyurt, & Ültay, 2021). In addition, a frequency table has been used to reveal the answers provided by mathematics teachers to mathematical literacy questions according to the proficiency level table.

Validity and Reliability

No time limit was given for the teachers to respond to the form and they were allowed to think comfortably. Thus, they had enough time to evaluate the opinion form and questions. In addition, the answers of the teachers who answered all the questions as the levels given by PISA were eliminated in case the teachers had seen the questions anywhere before and knew their level. Furthermore, the answers provided by the teachers to the questions were coded by both researchers, and the reliability of the data was calculated using the formula 'Reliability = Agreement / (Agreement + Disagreement)' (Miles & Huberman, 1994). Upon computation, the analysis yielded a notable (87%) concurrence rate among the codings. Subsequently, consensus was diligently attained through collaborative deliberation between the two researchers with respect to discrepant codings, thus culminating in the establishment of the definitive coding framework. Furthermore, to fortify the rigor of the coding process, the codings were subjected to scrutiny by two eminent mathematics educators distinguished in the field.

Results

Firstly, mathematics teachers working in middle and high schools were provided with the mathematical literacy proficiency table created by PISA. They were then asked to examine the level descriptions. Teachers were instructed to look into aspects such as the clarity and comprehensibility of the level table. In the second stage, teachers were presented with seven questions, one from each level, and they were asked to assign levels to these questions using the proficiency level table. Consequently, the viewpoints of the teachers pertaining to the proficiency level table underwent coding procedures and were subsequently organized into tabular format for systematic presentation and analysis. Finally, the levels assigned by the teachers to the questions were organized using a frequency table. In Table 3, the opinions of mathematics teachers regarding the language of the mathematical literacy proficiency level table are presented.

Table 3

The Opinions of Mathematics Teachers About The Language of The Mathematics Literacy Proficiency Table

Teacher Opinions	Number of Teachers	Percentage
Understandable	156	78%
It should be simpler	27	13%
Academic language is used	2	1%
An example should be given	2	1%
Boring	2	1%
No opinion stated	12	6%
Total	201	100%

When Table 3 was examined, 156 teachers (78%) stated that the language of the mathematics literacy proficiency table was understandable. 27 teachers (13%) said that it should be simpler. 2 teachers (1%) stated that an academic language was used. 2 teachers (1%) confirmed that an example should be given, and 2 teachers (1%) stated that it was boring. 12 teachers (6%) did not express their opinions.

The views on the language of the mathematics literacy proficiency level table given to the mathematics teachers are presented in Table 1. Upon scrutiny of Table 1, it becomes evident that the majority of teachers concur on the overall comprehensibility of the mathematical literacy proficiency level table. In terms of comprehensibility, Teacher A28 provided feedback in the form of, "It is articulated in a lucid manner, and I perceive no notable issues," while Teacher A46 expressed, "It exhibits an adequate level of clarity through its expression in fluent Turkish." However, with respect to simplicity, Teacher A35 opined, "I discern an excess of protracted sentences, some of which bear similarity to each other," and Teacher A38 commented, "There exists a certain verbosity in the text, warranting potential simplification." Regarding the use of an academic language, the teacher with the code A16 said, "An academic language was used too much. What is meant to be explained can be explained in simpler words and in a shorter way". The teacher with the code A64 about the subject of "An example should be given" said "It needs to give a more detailed explanation in the process from level 0 to level 3. It can be exemplified", The teacher coded A189 said, "I think that the difference between the 6th and 5th levels is not very different from the ones given. It will be more understandable if examples are made for both levels.", Teacher coded A20 stated their views about boringness as "It looks boring so I didn't want to read it", and teacher coded A100 stated that "There are too many repetitions and it can be boring to read the same things". In addition, some teachers did not want to express any opinions. In Table 4, the opinions of mathematics teachers regarding the levels in the mathematical literacy proficiency level table are presented.

Table 4

Opinions of Mathematics Teachers About The Levels in The Mathematics Literacy Proficiency Table

Teacher Opinions	Number of Teachers	Percentage
Understandable	142	71%
It is not clear	23	11%
Levels nested	10	5%
Not understood	8	4%
Requires detailed reading	2	1%
Written in academic language	1	0,5%
Examples of levels should be given	1	0,5%
No opinion stated	14	7%
Total	201	100%

When Table 4 was examined, 142 teachers (71%) stated that the language of the mathematics literacy proficiency table was understandable. 23 teachers (11%) said that it was not clear. 10 teachers (5%) stated that the levels were intertwined. 8 teachers (4%) confirmed that it was not understandable, 2 teachers (1%) stated that it needed detailed reading. 1 teacher (0.5%) stated that academic language was used. 1 teacher (0.5%) stated that an example should be given about the levels. 14 teachers (7%) did not express their opinions.

The opinions about the levels in the mathematics literacy proficiency level table given to the mathematics teachers are presented in Table 2. When Table 2 is examined, it is seen that the teachers find the levels in the mathematical literacy proficiency level table to be generally understandable. On the other hand, the teachers' comments about the table were as follows: "It is understood" by the teacher with the code A3 and as "understandable" by the teacher with the code A21. While A97 coded teacher said, "I think some situations are intertwined", A105 coded teacher replied, "Although the transitions are not sharp, there are intertwined transitions." Regarding the text written in an academic language, the teacher with the code A77 replied, "Anyone who has a good command of the academic language can understand it". While the teacher coded A75 said "There are no clear distinctions between the levels", the teacher coded A139 used the statement "The expected behaviors at some levels are quite close to each other, it can be difficult to distinguish". A124 coded teacher about reading in detail stated " It can be understood when read in detail". Regarding the statement about "not understood", A10 coded teacher said, "Simple operations at level 0 can be more explanatory. While non-decimal subtraction is easy, decimal subtraction can be difficult. The same applies to the 1st level"; on the other hand, the teacher coded A31 said, "It is noticed that it is written only from highly talented to less talented. Regarding the statement concerning content comprehension, the teacher designated as S55 remarked, "The content is challenging to apprehend." In relation to the suggestion regarding the provision of exemplars for each proficiency level, Teacher S55 articulated, "I posit that incorporating

illustrative questions or scenarios alongside each proficiency level would enhance the table's overall clarity and comprehensibility." As the stages rise, it would be appropriate to state that ..... can do it, but ...... cannot. Thus, it will be easier for the reader and the researcher to distinguish the levels from each other". In addition, some teachers did not want to express any opinions. Mathematics teachers were given a proficiency level table and asked to give a level to mathematical literacy questions. In the second stage, the questions posed to teachers to determine the question levels were presented before the answers given for each level. The question used for Which Car?-Level 0 is presented below.

Figure 1

Which Car?-Level 0

Chris has just received her car driving licence and wants to buy her first car.

This table below shows the details of four cars she finds at a local car dealer.

Model:	Alpha	Bolte	Castel	Dezal
Year	2003	2000	2001	1999
Advertised price (zeds)	4800	4450	4250	3990
Distance travelled (kilometres)	105 000	115 000	128 000	109 000
Engine capacity (litres)	1.79	1.796	1.82	1.783

Chris wants a car that meets **all** of these conditions:

- The distance travelled is **not** higher than 120 000 kilometres.
- It was made in the year 2000 or a later year.
- The advertised price is **not** higher than 4500 zeds.

Which car meets Chris's conditions?

A Alpha
B Bolte
C Castel
D Dezal

The Level 0 question in Figure 1 is the easiest question asked by PISA. In this study, the question "Which Car?" was used. The solution to this question involves interpreting the table according to the given criteria. The levels assigned by the teachers to this question are presented in Table 5.

Table 5

Level Estimations of Mathematics Teachers for Which Car-Level 0 Question

Level	Teacher Categories	Frequency
Level 0	A4, A19, A72, A90, A101, A163	6
Level 1	A16, A17, A27, A35, A52, A77, A80, A82, A89, A111, A116, A118, A121, A123, A126, A127, A139, A142, A148, A153, A166, A168, A177, A182, A192, A195	26
Level 2	A10, A24, A30, A31, A34, A38, A42, A45, A53, A55, A64, A75, A92, A97, A99, A112, A128, A133, A151, A152, A156, A161, A171, A179, A180, A184, A191, A193	28
Level 3	A1, A22, A23, A28, A32, A40, A54, A63, A69, A73, A86, A104, A105, A115, A117, A122, A125, A129, A132, A137, A141, A143, A145, A155, A162, A165, A170, A172, A173, A186, A189, A200	32
Level 4	A14, A33, A41, A44, A46, A50, A51, A56, A62, A76, A78, A83, A85, A93, A94, A102, A106, A107, 109, A120, A130, A135, A144, A149, A150, A164, A169, A174, A178, A187, A196, A198, A201	33
Level 5	A3, A5, A6, A7, A8, A9, A13, A18, A20, A21, A29, A36, A37, A43, A48, A59, A61, A66, A70, A74, A88, A96, A103, A114, A124, A147, A158, A183, A185, A188, A190, A197, A199	33
Level 6	A2, A12, A15, A25, A26, A39, A47, A49, A57, A58, A65, A67, A68, A71, A79, A84, A87, A95, A98, A108, A110, A119, A131, A136, A146, A157, A159, A167, A175, A176, A194	31
Indecisive	A11, A60, A81, A91, A100, A113, A134, A138, A140, A154, A160, A181	12
Total		201

As can be seen from the table, out of the 201 mathematics teachers participating in the research, only 6 of them were able to correctly determine the level of the "Which Car - Level 0" question. 26 teachers as level 1, 28 teachers as level 2, 32 teachers as level 3, 33 teachers as level 4, 33 teachers as level 5, 31 teachers as level 6. 12 teachers were indecisive. Teachers gathered at Level 3, 4, 5 and 6 on this question. The question used for Charts-Level 1 is presented below.

Figure 2

Charts-Level 1

In January, the new CDs of the bands *4U2Rock* and *The Kicking Kangaroos* were released. In February, the CDs of the bands *No One's Darling* and *The Metalfolkies* followed. The following graph shows the sales of the bands' CDs from January to June.

Sales of CDs per month
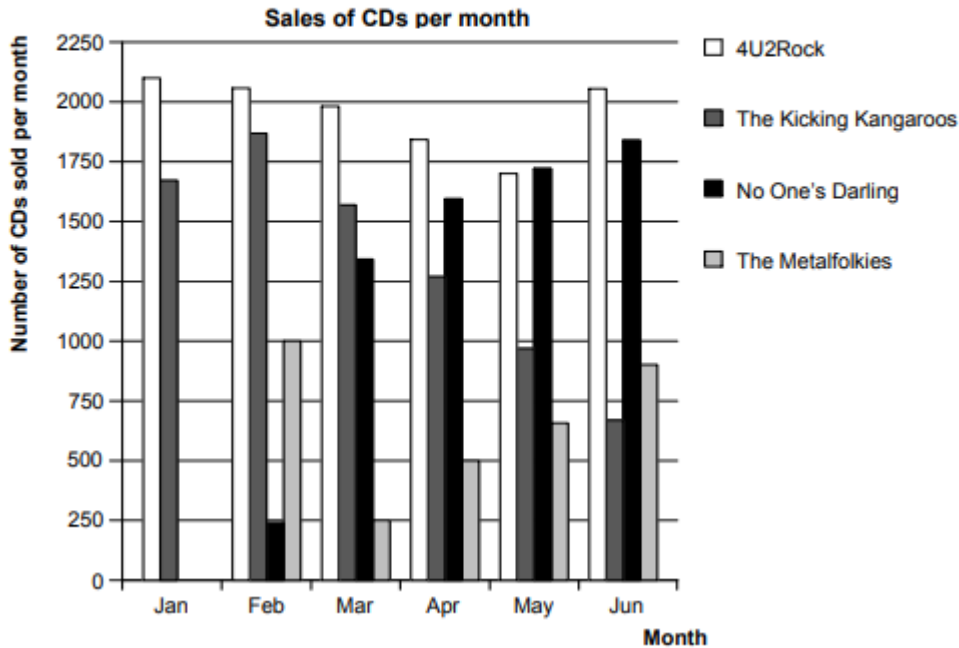
In which month did the band *No One's Darling* sell more CDs than the band *The Kicking Kangaroos* for the first time?

A   No month
B   March
C   April
D   May

    Level 1 is one of the easy level questions asked by PISA. In this study, the question "Charts" was used. When answering this question, it is necessary to interpret the given column charts.   The proficiency levels ascribed by the teachers to this particular inquiry are delineated and presented in Table 6.

Table 6

Level Estimations of Mathematics Teachers for The Question of Charts-Level 1

Level	Teacher Categories	Frequency
Level 0	A16, A17, A19, A72, A73, A90, A108, A111, A142, A163, A166, A168, A177, A182	14
Level 1	A12, A24, A25, A32, A34, A35, A40, A46, A47, A53, A63, A64, A75, A77, A78, A89, A112, A118, A121, A126, A139, A143, A185	23
Level 2	A4, A10, A23, A26, A31, A41, A45, A54, A55, A56, A62, A65, A79, A86, A98, A101, A117, A129, A134, A137, A141, A145, A19, A151, A152, A153, A156, A162, A171, A179, A180, A186, A192	33
Level 3	A1, A8, A9, A14, A22, A30, A42, A49, A50, A60, A70, A74, A82, A92, A97, A99, A105, A109, A120, A122, A124, A125, A128, A132, A133, 135, A148, A150, A155, A161, A165, A173, A184, A189, A190, A191, A194, A197, A198	40
Level 4	A15, A21, A28, A33, A48, A52, A69, A80, A85, A87, A88, A102, A103, A104, A115, A123, A127, A130, A146, A147, A170, A172, A188, A193, A195, A200, A201	27
Level 5	A2, A5, A18, A20, A29, A36, A39, A43, A44, A51, A59, A61, A71, A76, A83, A95, A106, A107, A110, A116, A144, A158, A159, A164, A169, A178, A183, A187	28
Level 6	A3, A7, A13, A27, A37, A57, A58, A66, A67, A68, A93, A96, A114, A119, A131, A136, A157, A167, A175, A176, A196, A199	22
Indecisive	A6, A11, A38, A81, A91, A94, A100, A113, A138, A140, A154, A160, A174, A181	14
Total		201

As delineated in the table, a discernible trend emerges from the responses of the 201 mathematics educators who participated in this research. Specifically, only 23 of them demonstrated an accurate proficiency level determination for the question titled "Charts - Level 1." Among the respondents, 14 teachers classified it as Level 0, 33 teachers adjudged it as Level 2, 40 teachers categorized it as Level 3, 27 teachers assessed it as Level 4, 28 teachers ascribed it to Level 5, and 22 teachers attributed it to Level 6, while 14 teachers remained uncertain in their evaluation. Notably, the consensus among the teachers converged predominantly toward Level 3 for this particular question, which pertains to the "Charts - Level 1" category.

Figure 3

Staircase-Level 2

The diagram below illustrates a staircase with 14 steps and a total height of 252 cm:

Total height 252 cm

Total depth 400 cm
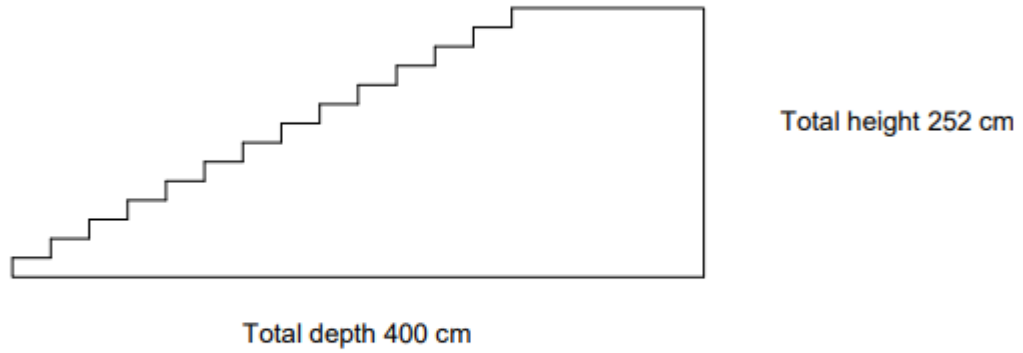
What is the height of each of the 14 steps?

Height: ....cm.

Level 2 is one of the questions asked by PISA, which is described as easy. In this study, the question "Staircase" was used. The correct answer to this question is to discover that the height is evenly distributed to each step. The levels assigned by the teachers to this question are presented in Table 7.

Table 7

Level Estimations of Mathematics Teachers for Staircase-Level 2 Question

Level	Teacher Categories	Frequency
Level 0	A17, A27, A70, A72, A82, A90, A110, A116, A143, A168, A185, A189, A197	13
Level 1	A4, A10, A26, A30, A54, A64, A77, A86, A89, A102, A121, A123, A142, A145, A151, A152, A159, A165, A179	19
Level 2	A13, A14, A22, A23, A24, A31, A32, A35, A40, A41, A43, A46, A47, A50, A53, A62, A63, A69, A74, A75, A78, A87, A111, A112, A117, A120, A126, A127, A128, A137, A141, A149, A153, A156, A161, A162, A166, A170, A182, A186, A192, A193	42
Level 3	A1, A2, A16, A19, A20, A21, A28, A29, A33, A34, A42, A45, A49, A52, A56, A73, A76, A79, A80, A84, A97, A98, A99, A101, A103, A104, A105, A106, A115, A118, A122, A124, A125, A129, A133, A134, A139, A146, A148, A163, A167, A171, A172, A175, A178, A200, A201	47
Level 4	A3, A15, A25, A38, A51, A55, A61, A83, A88, A92, A94, A95, A107, A130, A132, A147, A150, A155, A157, A158, A164, A169, A180, A183, A184, A190, A191, A195, A198	29
Level 5	A5, A9, A39, A44, A48, A59, A60, A67, A85, A93, A96, A109, A114, A144, A173, A174, A176, A177, A187, A194, A196	21
Level 6	A7, A8, A12, A18, A36, A37, A57, A58, A65, A66, A68, A71, A108, A119, A131, A135, A136, A199	18
Indecisive	A6, A11, A81, A91, A100, A113, A138, A140, A154, A160, A181, A188	12
Total		201

As can be seen from the table, out of the 201 mathematics teachers participating in the research, only 42 of them were able to correctly determine the level of the "Staircase - Level 2" question. 13 teachers answered the question as Level 0, 19 teachers as level 1, 47 teachers as level 3, 29 teachers as level 4, 21 teachers as level 5, 18 teachers as level 6. 12 teachers were indecisive. Teachers gathered at Level 2 and 3 on this question. The question used for Internet Relay Chat-Level 3 is presented below.

Figure 4

Internet Relay Chat-Level 3

Mark (from Sydney, Australia) and Hans (from Berlin, Germany) often communicate with each other using "chat" on the Internet. They have to log on to the Internet at the same time to be able to chat.

To find a suitable time to chat, Mark looked up a chart of world times and found the following:

Greenwich 12 Midnight   Berlin 1:00 AM   Sydney 10:00 AM

At 7:00 PM in Sydney, what time is it in Berlin?

Answer: ....

Level 3 is one of the intermediate-level questions asked by PISA. In this study, the question "Internet Relay Chat" was used. To find the correct answer within the scope of this question, it is necessary to calculate the time differences between countries and select the appropriate operation. The levels assigned by the teachers to this question are presented in Table 8.

Table 8

Level Estimations of Mathematics Teachers for Internet Relay Chat-Level 3 Question

Level	Teacher Categories	Frequency
Level 0	A20, A22, A53, A80, A90, A101, A163	7
Level 1	A12, A19, A24, A30, A52, A54, A62, A70, A71, A77, A82, A127, A138, A139, A142, A155, A161, A166, A174, A175, A189	21
Level 2	A3, A15, A16, A27, A32, A35, A38, A43, A64, A69, A86, A89, A92, A93, A94, A102, A117, A120, A123, A126, A129, A143, A148, A150, A156, A165, A172, A177, A179, A182, A186, A188	32
Level 3	A1, A10, A18, A29, A31, A34, A44, A45, A46, A50, A56, A63, A72, A75, A76, A78, A87, A97, A98, A103, A106, A107, A110, A111, A118, A121, A128, A130, A133, A137, A141, A144, A145, A147, A149, A151, A152, A162, A167, A168, A169, A170, A171, A180, A183, A184, A185, A190, A192, A193, A200, A201	52
Level 4	A4, A6, A8, A14, A17, A21, A23, A28, A33, A39, A40, A41, A42, A47, A48, A49, A55, A59, A60, A67, A73, A74, A84, A85, A88, A96, A99, A104, A105, A109, A112, A115, A116, A124, A125, A135, A157, A158, A159, A164, A173, A187, A197, A198	44
Level 5	A5, A7, A9, A25, A26, A36, A37, A51, A57, A58, A61, A79, A83, A95, A122, A131, A134, A136, A146, A153, A176, A191, A194, A196	24
Level 6	A13, A65, A66, A68, A108, A114, A119, A132, A178, A199	10
Indecisive	A2, A11, A81, A91, A100, A113, A140, A154, A160, A181, A195	11
Total		201

Evident in the tabulated data, within the cohort of 201 mathematics educators engaged in the research, a mere 52 of them exhibited the capacity to accurately ascertain the proficiency level of the "Internet Relay Chat - Level 3" question. Notably, 7 teachers categorized it as Level 0, 21 teachers attributed it to Level 1, 32 teachers assigned it to Level 2, while 44 teachers elevated it to Level 4. Moreover, 24 teachers designated it as Level 5, and 10 teachers positioned it at Level 6. Concurrently, 11 teachers remained ambivalent in their determination of the question's proficiency level. This discernible distribution of responses highlights a predominant consensus among teachers, primarily clustering around Level 3 for the "Internet Relay Chat - Level 3" question. Teachers gathered at Level 3 on this question. The question used for Coloured Candies-Level 4 is presented below.

Figure 5

Coloured Candies-Level 4

Robert's mother lets him pick one candy from a bag. He can't see the candies. The number of candies of each colour in the bag is shown in the following graph.
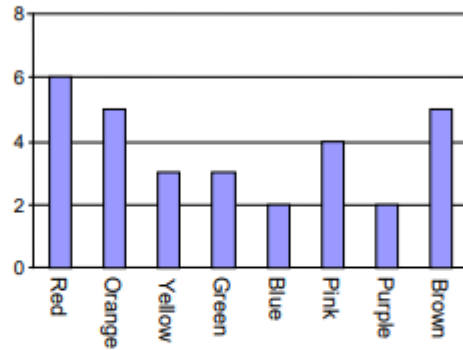
What is the probability that Robert will pick a red candy?

A 10%
B 20%
C 25%
D 50%

Level 4 is one of the questions asked by PISA, which is described as intermediate. In this study, the question "Coloured Candies" was used. To find the correct answer to this question, it is necessary to interpret the graph correctly and perform the percentage calculation accurately. The levels assigned by the teachers to this question are presented in Table 9.

Table 9

Level Predictions Made by Mathematics Teachers for The Coloured Candies-Level 4 Question

Level	Teacher Categories	Frequency
Level 0	A17, A64, A82, A90, A110	5
Level 1	A54, A62, A72, A77, A102, A193, A197	7
Level 2	A4, A10, A19, A22, A23, A24, A25, A27, A31, A34, A46, A47, A50, A52, A53, A75, A78, A80, A86, A92, A111, A112, A116, A121, A123, A126, A128, A134, A142, A145, A149, A152, A156, A162, A172, A173, A182, A192	38
Level 3	A1, A12, A14, A26, A30, A33, A35, A38, A41, A42, A45, A55, A56, A59, A69, A73, A84, A88, A94, A98, A101, A103, A104, A107, A115, A117, A118, A130, A133, A137, A139, A143, A147, A148, A155, A161, A163, A171, A177, A179, A183, A184, A195, A198, A200	45
Level 4	A2, A9, A16, A20, A21, A28, A29, A32, A40, A51, A63, A65, A66, A70, A79, A89, A95, A96, A97, A105, A106, A109, A120, A124, A127, A132, A141, A144, A151, A153, A157, A158, A159, A164, A165, A169, A170, A174, A175, A178, A180, A185, A186, A188, A189, A190, A194	47
Level 5	A3, A15, A18, A39, A43, A44, A48, A49, A61, A67, A76, A83, A85, A93, A99, A122, A125, A129, A135, A146, A150, A166, A168, A187, A201	25
Level 6	A5, A7, A8, A36, A37, A57, A58, A68, A71, A74, A87, A108, A114, A119, A131, A136, A167, A176, A191, A196, A199	21
Indecisive	A6, A11, A13, A60, A81, A91, A100, A113, A138, A140, A154, A160, A181	13
Total		201

As can be seen from the table, out of the 201 mathematics teachers participating in the research, only 47 of them were able to correctly determine the level of the "Coloured Candies - Level 4" question. 5 teachers answered the question as Level 0, 7 teachers as level 1, 38 teachers as level 2, 45 teachers as level 3, 25 teachers as level 5, 21 teachers as level 6. A notable observation arises from the dataset, indicating that 13 teachers exhibited indecision in their proficiency level assignments for this specific question. Remarkably, a discernible convergence among teachers was discerned, with the majority gravitating towards Level 3 and Level 4 in their assessment of the "Internet Relay Chat - Level 3" question. The question used for Test Scores-Level 5 is presented below.

Figure 6

Test Scores-Level 5

The diagram below shows the results on a Science test for two groups, labelled as Group A and Group B.

The mean score for Group A is 62.0 and the mean for Group B is 64.5. Students pass this test when their score is 50 or above.

Scores on a Science test
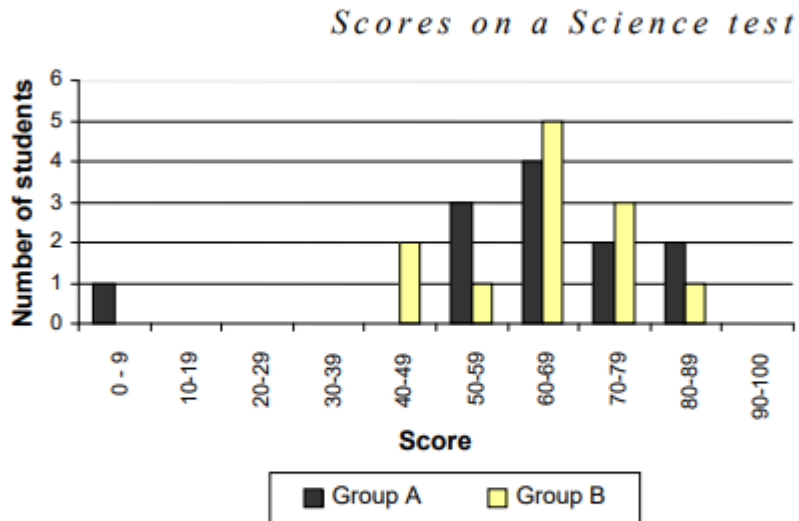
Looking at the diagram, the teacher claims that Group B did better than Group A in this test.

The students in Group A don't agree with their teacher. They try to convince the teacher that Group B may not necessarily have done better.

Give one mathematical argument, using the graph, that the students in Group A could use.

   Level 5 is one of the difficult questions asked by PISA. In this study, the question 'Test Scores' was used. To find the correct answer to this question, it is necessary to first interpret the graphs correctly and make accurate decisions about the evidence to be used (other than the arithmetic mean). The levels assigned by the teachers to this question are presented in Table 10.

Table 10

Level Estimations of Mathematics Teachers for The Question of Test Scores-Level 5

Level	Teacher Categories	Frequency
Level 0	A90, A108	2
Level 1	---	0
Level 2	A30, A82, A87, A92, A99, A112, A179, A196	8
Level 3	A1, A17, A19, A22, A31, A32, A38, A53, A54, A60, A88, A89, A94, A129, A137, A146, A151, A198	18
Level 4	A3, A9, A13, A24, A33, A34, A35, A40, A42, A44, A45, A46, A49, A63, A69, A72, A73, A74, A75, A77, A80, A83, A84, A85, A86, A95, A96, A101, A103, A104, A107, A110, A111, A115, A177, A122, A123, A126, A128, A130, A132, A135, A139, A142, AA143, A144, A150, A152, A155, A162, A163, A164, A166, A169, A172, A173, A178, A190, A192, A195, A200	61
Level 5	A2, A8, A10, A15, A20, A23, A25, A27, A36, A37, A41, A43, A47, A48, A50, A55, A56, A57, A58, A61, A62, A64, A67, A71, A78, A93, A97, A102, A106, A120, A121, A133, A141, A145, A148, A149, A153, A158, A159, A161, A165, A170, A171, A180, A182, A183, A186, A187, A188, A189, A193, A201	52
Level 6	A4, A5, A7, A12, A14, A16, A18, A21, A26, A28, A29, A39, A51, A52, A59, A65, A66, A68, A70, A76, A79, A98, A105, A109, A114, A116, A118, A119, A124, A125, A127, A131, A134, A136, A147, A156, A157, A167, A168, A174, A175, A176, A177, A184, A185, A191, A194, A197, A199	49
Indecisive	A6, A11, A81, A91, A100, A113, A138, A140, A154, A160, A181	11
Total		201

As can be seen from the table, out of the 201 mathematics teachers participating in the research, only 52 of them were able to correctly determine the level of the "Test Scores - Level 5" question. 2 teachers answered the question as Level 0, 8 teachers as level 2, 18 teachers as level 3, 61 teachers as level 4, 49 teachers as level 6 and no teachers as level 1. 11 teachers were indecisive. Teachers gathered at Level 4 and 5 on this question. The question used for Carpenter-Level 6 is presented below.

Figure 7

Carpenter-Level 6

A carpenter has 32 metres of timber and wants to make a border around a garden bed. He is considering the following designs for the garden bed.

A   6 m   10 m

B   6 m   10 m

C   6 m   10 m

D   6 m   10 m
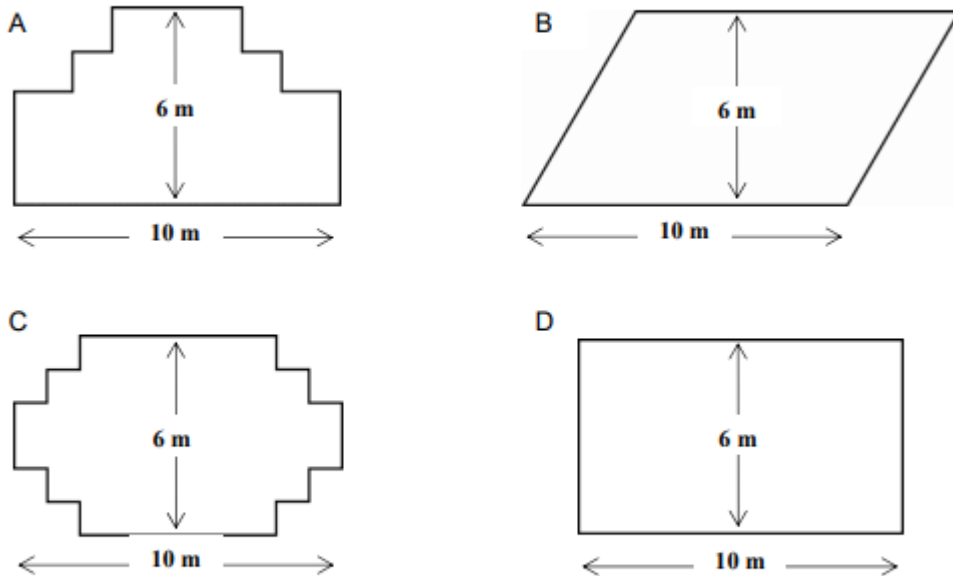
Circle either "Yes" or "No" for each design to indicate whether the garden bed can be made with 32 metres of timber.

Garden bed design	Using this design, can the garden bed be made with 32 metres of timber?
Design A	Yes / No
Design B	Yes / No
Design C	Yes / No
Design D	Yes / No

Level 6 is the most difficult question asked by PISA. In this study, the question 'Carpenter' was used. To solve this question correctly, it is necessary to know and apply the geometric properties of shapes (perimeter, Pythagorean relationship). The levels assigned by the teachers to this question are presented in Table 11.

Table 11

Level Estimations of Mathematics Teachers for The Question of Carpenter-Level 6

Level	Teacher Categories	Frequency
Level 0	A90	1
Level 1	A53, A82, A163	3
Level 2	A17, A22, A30, A46, A62, A80, A87, A89, A101, A111, A124, A127, A132, A142, A152, A159, A164, A179, A189, A192, A197	21
Level 3	A4, A12, A14, A19, A24, A32, A34, A38, A40, A41, A44, A47, A54, A56, A69, AA70, A72, A75, A77, A86, A88, A93, A94, A99, A102, A104, A107, A112, A116, A117, A120, A123, A129, A139, A147, A150, A156, A161, A162, A165, A166, A169, A170, A172, A174, A175, A182, A186, A188	49
Level 4	A1, A2A8, A10, A18, A23, 27, 29, A31, A33, A35, A42, A43, A45, A50, A55, A59, A60, A61, A63, A64, A73, A74, A76, A79, A84, A85, A95, A97, A103, A115, A121, A122, A125, A128, A134, A137, A141, A143, A145, A146, A148, A149, A151, A153, A155, A158, A168, A171, A173, A177, A180, A183, A184, A190, A194, A198, A200, A201	59
Level 5	A3, A6, A15, A16, A21, A25, A28, A36, A39, A48, A49, A51, A52, A57, A58, A66, A67, A78, A83, A92, A96, A98, A105, A106, A109, A110, A118, A126, A130, A133, A135, A144, A157, A167, A178, A185, A187, A193, A199	39
Level 6	A5, A7, A9, A13, A26, A37, A65, A68, A71, A108, A114, A119, A131, A136, A176, A191, A195, A196	18
Indecisive	A11, A20, A81, A91, A100, A113, A138, A140, A154, A160, A181	11
Total		201

As can be seen from the table, out of the 201 mathematics teachers participating in the research, only 18 of them were able to correctly determine the level of the 'Carpenter - Level 6' question. 1 teacher answered the question as Level 0, 3 teachers as level 1, 21 teachers as level 2, 49 teachers as level 3, 59 teachers as level 4, 39 teachers as level 5. 11 teachers were indecisive. Teachers gathered at Level 4 on this question.

In addition, in the question of "Internet Relay Chat-Level 3", the teachers stated that there are spelling forms that are not suitable for Turkish and expressions that are not in Turkish are used. In Turkish time writing, "." instead of ":" is preferred between hours. Again, there is no such time as "24.00" in Turkish. In lieu of an alternative, the expression "00.00" is employed to delineate the specific temporal reference under consideration.

Discussion, Conclusion & Suggestions

According to the teachers' opinions about the proficiency level table, although the teachers expressed that they understood the table, they stated that the language of the table should be simplified. In addition, some teachers did not want to express their opinions about the language of the table. Teachers were tasked with assigning proficiency levels to the questions in accordance with the provided proficiency level table. Although the teachers stated that they understood the table, they could not decide, although they had problems in assigning levels to the questions. As also stated by Sönmez and Kaleli-Yılmaz (2021), middle school teachers were unable to assign levels to the questions. However, mathematics literacy is emphasized in undergraduate and graduate education. But as seen in the results of this study, the concepts taught in classes remain theoretical for teachers. This circumstance may be construed as indicative of a deficiency in experiential familiarity. These situations have led to the idea that teachers do not have an idea about mathematical literacy. As emphasized by Kozaklı-Ülger, Bozkurt, and Altun (2022), one of the reasons why teachers have problems in mathematical literacy is their lack of experience related to mathematical literacy. The result obtained from this study led to the thought that the problems experienced by teachers in mathematical literacy may be due to their lack of experience in mathematical literacy.

As discerned within the findings, it becomes evident that educators encountered substantial challenges in the process of assigning proficiency levels to the questions, guided by the mathematical literacy proficiency level table disseminated by PISA, which delineated explicit proficiency levels for the respective questions. The number of teachers who could accurately determine the levels of the questions is quite low. To give an example, in a study involving 201 mathematics teachers, only 6 teachers could correctly match the Level 0 question with Level 0. This is a very concerning situation. As the levels of the questions increase, the number of mathematics teachers making correct predictions also increases. However, the number of mathematics teachers who can make accurate predictions is still not sufficient. All of this indicates that the proficiency level table is not fully fulfilling its purpose. This circumstance, as duly underscored by Altun (2020), implies that the proficiency level table may not effectively or faithfully encapsulate the precise proficiency levels associated with the individual questions in question. At the same time, this situation raises the thought that students' proficiency levels may not be accurately determined either. In light of these results, there is a need for a serious revision of the proficiency level table. As stated by Dilekçi and Çiçekçi (2022), the most important factor in the PISA assessment is the ability to read and understand correctly and apply what is read.

This study was conducted in 2022, and the data was collected in the same year. As seen in the results of this study, the levels are not fully understood and cannot be accurately determined. PISA administrators are aware of this situation, which is why in the most recent assessment, they have added new levels to the mathematical literacy table. Level 0, which is practical but not visible in theory, has gained more importance. In response to this observation, it has been deemed necessary to subdivide Level 1 into three discrete tiers, namely Level 1a, Level 1b, and Level 1c, thereby introducing an additional proficiency level to the existing table. Consequently, the total number of proficiency levels has been augmented to encompass eight, as documented in OECD's recent report (OECD, 2023).

Teachers also stated that there are spelling forms in the questions that do not comply with the Turkish spelling rules. As elucidated by Asar (2019), it is noteworthy that the presence of measurement invariance remains notably absent among participants representing diverse linguistic backgrounds who partake in the administration of the PISA examination. In light of this result, it is possible to encounter spelling errors in the translations of the PISA exams. As also stated by Kıbrıslıoğlu (2015), there is also no measurement invariance across cultures in PISA exams. However, in an international practice like PISA, it is surprising that questions are written without paying attention to the spelling rules of the participating countries.

According to all the results obtained, it was found appropriate to make the following recommendations.

● While translating the PISA application, which is an international exam, interdisciplinary studies should be carried out and translations should be shown to experts in both Turkish and English.

● Turkish spelling and grammar rules should be observed in the translations of the PISA application.

● More work should be done on issues related to teachers' views on mathematical literacy.

● Teachers should be given in-service training to increase their knowledge about mathematical literacy.

● Teachers should improve themselves about PISA application and mathematical literacy questions.

Ethic

In this study, all the rules specified to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, were not taken. Before starting the research, Bursa Uludağ University Social and Human Sciences Research and Publication Ethics Committee was applied and the necessary ethics committee approval was obtained with the date of 26.03.2021, session 2021-03 and document number E-20585590-302.08.01-1480.

Author Contributions

All authors contributed to the manuscript equally.

Conflict of Interest

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A Comparative Glance At Teaching Practice of Mother Tongue Teacher Candidates in Türkiye and United Kingdom

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Abstract

This research aimed to determine how prospective secondary school language teachers conduct their teaching practicum in the United Kingdom and Türkiye. The study was designed using a multiple-case holistic design. Accordingly, data for the research were collected through document analysis and interviews. Data related to the teaching practicum in the Turkish Language Teaching program at Kırşehir Ahi Evran University Faculty of Education in Türkiye were obtained through document analysis. Data regarding the teaching practicum in the Postgraduate Certificate in Education program for secondary English teaching at the University of Reading Faculty of Education in the United Kingdom were obtained through document analysis and interviews with faculty members at the institution. It is evident that while the instructional content of teaching practicums in both nations exhibits substantial similarities, a notable disparity emerges with regard to the temporal extent of the practicum experience afforded to prospective secondary school language educators. As a result, the process of teaching practicums for secondary school language teacher candidates differs between Türkiye and the UK in terms of practicum hours, school diversity, and assessment methods.

Key Words

Native language teaching • Teaching practice • Teacher training

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Concepts

"Teacher training" is a process where theoretical and practical courses are conducted together to enhance the skills of teacher candidates. Aspects such as the selection of teacher candidates, pre-service education, the practical (internship) period, and monitoring-evaluation activities during this period, as well as in-service training, all fall within the scope of the concept of teacher training (Kavcar, 2002; Oğuzkan, 1983). The practical application of theoretical knowledge in the field of educational sciences and subject-specific education during internships stands as a pivotal element within teacher training establishments. In the present context, the attainment of professional competence by teacher candidates hinges upon their aptitude for executing practical applications within internship schools and effectively translating their subject-specific educational knowledge acquired in theoretical settings into practical pedagogical implementation (Beeth & Adadan, 2006; Poulou, 2007).

Alongside the teaching practicum, aspiring teachers have the opportunity to enhance their subject knowledge and engage in instructional planning. All of these actions carried out during the practicum occur through the exchange of knowledge with peers, instructors, and cooperating teachers. Throughout the pre-service phase, the comprehension of school organization and operational dynamics plays a pivotal role in enhancing the preparedness of teacher candidates as they embark on their professional journey subsequent to their formal appointment. Therefore, the school experience that teachers undergo during the pre-service period is also crucial. Indeed, studies focusing on trainee teachers achievement and teacher quality show the relationship between pre-service education and experience (Hanushek & Rivkin, 2012; Kunzman, 2002; Seifried, 2012).

Research related to teacher education indicates that when teacher candidates are adequately prepared for the act of teaching, they are more successful and confident (Darling-Hammond, 2000; Seifried, 2012). Therefore, pre-service education and teaching practicum play crucial roles in preparing teacher candidates to become qualified teachers in the future. Indeed, upon scrutinizing the teacher training systems of developed nations, it becomes conspicuously apparent that the teaching practicum occupies a salient and pivotal position.

Organizations such as the Organisation for Economic Co-Operation and Development [OECD], the World Bank, the United Nations Educational, Scientific and Cultural Organization [UNESCO], and the European Union [EU] aim to improve education worldwide through comparative education studies. Therefore, the comparative education research conducted by these organizations regarding teacher education helps countries to assess their current situations, identify issues, and gain a better understanding of their education systems. The results of exams such as Trends in Programme for International Student Assessment [PISA] and International Mathematics and Science Study [TIMSS] also provide a comparative perspective on countries' education systems at an international level (Wiseman, 2013). In the context at hand, the examination of teacher training systems in countries that exhibit notable performance in international examinations constitutes a valuable endeavor, facilitating a comparative assessment of nations and providing enhanced insights into their respective educational landscapes.

When examining research in the literature that conducts cross-country comparisons of teacher training programs, it can be observed that comparisons involving Türkiye are often made with particularly developed countries like Finland, the United Kingdom [UK], and Germany. Among the compared countries, the United Kingdom, which has

maintained its success in PISA assessments since the year 2000, holds a prominent position (OECD, 2003; 2004; 2007; 2010; 2014; 2016). The existing body of literature encompasses a multitude of studies that compare the teacher training system of the United Kingdom with Türkiye and other countries (Aykaç, Kabaran, & Bilgin, 2014; Babayiğit, 2019; Bolat, 2006; Çakmakçı, 2017; Parmaksız & Kısakürek, 2013; Sağlam & Kürüm, 2005; Şahin, 2017; Yurdakal, 2018;). However, it is noted that these studies often do not include comparisons related to teaching practicums. When examining studies that comparatively analyze teaching practicums in teacher training programs across countries (Akdemir, 2021; Aytaç & Erk, 2018; Çakmakçı & Demir, 2021; Çam Tosun, 2019; Orhan & Kuyumcu Vardar, 2019; Uygun, Ergen, & Öztürk, 2011), Çakmakçı and Demir's (2021) research on teaching practicums in the process of training language teachers in Finland and Türkiye is present in the literature.

According to OECD (2014) data on an international level, the compulsory duration of pre-service teaching practicum is 120 days for the United Kingdom and 30 days for Türkiye. In order for countries to enhance their teacher training systems and cultivate qualified teachers, it is necessary to evaluate the practices of successful and developed countries at an international level. Therefore, within the context of all these research studies and mentioned data, this study encompasses a comparison of pre-service teaching practicum courses in teacher education in the UK and Türkiye. The analyzed teaching practicum course in the comparison is limited to the content of the teaching practicum in programs training secondary school language teachers in both countries. Consequently, the objective of this research is to juxtapose the teaching practicums of language educators in the United Kingdom and Türkiye, focusing on their curriculum components, and to underscore the resemblances and disparities existing between the two nations. Aligned with this overarching goal, the study's inquiries are formulated as follows:

1. How are teaching practicums conducted in secondary school language teacher training programs in the United Kingdom?

2. How are teaching practicums conducted in secondary school language teacher training programs in Türkiye?

Method

Research Design

In the context of this comparative educational research, the chosen methodology involves the utilization of a qualitative research approach known as holistic multiple case study design. Yin (2014) classifies case studies and explains the holistic multiple case design as involving multiple cases, each treated comprehensively within itself and then compared. With this design, a comparison can be made between the included or addressed cases (Yıldırım & Şimşek, 2011). Within the parameters of this investigation, the initial case pertained to the examination unit encompassing the pedagogical application undertaken by Turkish language teacher candidates within the Faculty of Education at Kırşehir Ahi Evran University [KAEU] in Kırşehir, Türkiye. The subsequent case pertained to the analytical framework focused on the pedagogical implementation pursued by prospective English language educators at the University of Reading [UR], situated in Reading, United Kingdom.

The object of analysis

This study centrally focuses its analytical efforts on the archival documentation pertaining to the practical pedagogical experiences imparted by educational establishments specializing in the instruction and cultivation of language educators within the educational contexts of both the United Kingdom and Türkiye. Table 1 provides an overview of the fundamental attributes of these aforementioned institutions.

Table 1

Basic Characteristics of Institutions Training Secondary School Language Teachers in the United Kingdom and Türkiye.

	Türkiye	United Kingdom
University	Kırşehir Ahi Evran University	University of Reading
Faculty	Faculty of Education	Instıtute of Education
Level of education	Undergraduate	Postgraduate
Duration of education	4 Years	3 Years Undergraduate + 1 Year PGCE

Founded in 1961, Kırşehir Ahi Evran University (KAEU) acquired its university status in 2006. The Faculty of Education, whose origins date back to 1961 as a Men's Teacher Training School, also holds the distinction of being the university's first faculty. The Turkish Language Education Department within the faculty is responsible for training Turkish language teachers at the undergraduate level as part of the Turkish Language and Social Sciences Education department. Similar to education faculties in other universities across Türkiye, this institution educates Turkish language teachers within the framework of the Turkish Language Education undergraduate program defined by the Council of Higher Education [CHE]. The teaching practicum course is conducted practically in schools during the seventh and eighth semesters of the undergraduate program. The course description for the teaching practicum is included in the Turkish Language Education Undergraduate Program defined by CHE (2018). For this study, documents related to the institution in Türkiye were accessed from the websites of the Council of Higher Education and the Ministry of National Education, and these documents were used as the object of analysis.

Established in 1892, the University of Reading [UR] is one of the leading universities situated in the largest non-city urban settlement in the UK. The UR's Faculty of Education encompasses various programs that train teachers for early childhood, primary, and secondary school levels. Within the academic purview of the institution, there exist Postgraduate Certificate in Education (PGCE) programs, situated at the master's level, encompassing a diverse spectrum of 17 distinct subject domains. These programs are tailored to cater to the educational needs of teacher candidates who have successfully completed their undergraduate degrees.

PGCE stands for "Postgraduate Certificate in Education," which is a master's level certificate program in teacher education offered in the UK and some other countries. This program aims to prepare teacher candidates with teaching and instructional skills. The PGCE program typically lasts for an academic year and combines theoretical education with practical teaching experiences. These programs provide education to teacher candidates in

pedagogical skills, classroom management techniques, trainee teachers assessment methods, and how to address trainee teachers diversity. Candidates interested in enrolling in the PGCE program are required to have an undergraduate degree. Throughout the program, teacher candidates receive theoretical coursework while also engaging in one or more teaching practicums at schools. These practicums allow teacher candidates to gain experience in the classroom and apply the pedagogical principles they have learned. PGCE programs aim to train teacher candidates as qualified and effective educators (Cabaroğlu & Roberts, 2000). The PGCE certificate program grants the teacher candidate the Qualified Teacher Status [QTS] required to work as a teacher in England. QTS is essential for teacher candidates to be recognized as professional teachers and to teach in schools in England (Department for Education, 2021).

In this study, the PGCE Secondary English programme at the UR's Faculty of Education has been examined. This program, offered at the postgraduate level, includes 1 year of university-based subject-specific education courses and teaching practicums. As this research focuses on teaching practicums, the documents related to the program's teaching practicum have been taken as the object of analysis. Additionally, interviews were conducted with faculty members from the UR's Faculty of Education to support the data obtained from the documents. The documents regarding the institution's teaching practicum were accessed from the university's official website, the official website of the Department for Education in the UK, and through email communication with the interviewed faculty members. These mentioned documents were taken as the object of analysis.

Research Instruments and Processes

Yıldırım and Şimşek (2011) proposed a procedural guideline for conducting a case study, comprising the subsequent stages: formulating research inquiries, demarcating sub-issues, delineating the unit of analysis, electing the specific case for investigation, defining the study cohort, collecting data, scrutinizing and construing data, and elucidating the study's outcomes.

Considering that the focal point of the study is the teaching practicum, an initial literature review was conducted on studies related to teaching practicums in Türkiye. Comparative research studies that analyze teaching practicums in teacher training programs across countries (Akdemir, 2021; Aytaç & Erk, 2018; Çakmakçı & Demir, 2021; Çam Tosun, 2019; Orhan & Kuyumcu Vardar, 2019; Sözer & Karakaş, 2018; Uygun, Ergen, & Öztürk, 2011) were reviewed. Çakmakçı and Demir's (2021) study, which focuses on the teaching practicums in the training of language teachers in Finland and Türkiye, was found. Within this contextual framework, it is worth noting that the existing body of scholarly literature has, hitherto, exhibited a conspicuous absence of comparative investigations explicitly dedicated to the scrutiny of teaching practicums undertaken by prospective language educators in the United Kingdom and the concomitant analysis vis-à-vis their counterparts in Türkiye. In light of this scholarly gap, the research topic was meticulously delineated, and the concomitant research problem was thoughtfully formulated.

In Türkiye, the data collection method used was the document analysis method commonly employed in qualitative research. Documents used in qualitative research, as indicated by Merriam (2009) and Bryman (2012), can be categorized into two classes: public and personal documents. In addition to official documents, online information and materials obtained through the internet can also be used as primary sources in research. Consonant

with this methodological orientation, data pertinent to this research endeavor were methodically garnered from an array of scholarly sources, including the official websites of governmental authorities, the curriculum documentation associated with Turkish language education programs, the syllabi pertaining to the teaching practicum course, and relevant written and published materials.

To collect data in the United Kingdom, the researcher first contacted a faculty member in the Secondary school English Education department at the UR via email, sharing the research topic and problem. Following that, an invitation was extended to the researcher to carry out the study at the UR. The data collection phase in the United Kingdom spanned a duration of 9 months, encompassing the academic year of 2019-2020. The sequence of data collection stages in the United Kingdom unfolded as outlined below:

The data collection procedure at the University of Reading encompassed the subsequent phases:

1. Examining the teacher training program implemented in the Faculty of Education at the University of Reading.

2. Analyzing the curriculum of the PGCE Secondary English programme.

3. Identifying the units responsible for the teaching practicum and conducting interviews with the responsible faculty members in these units.

4. Examining documents related to the teaching practicum.

5. Validating the information obtained from the documents by discussing their accuracy with the responsible faculty members.

6. Analyzing the documents.

7. Reporting the findings.

These steps were undertaken to comprehensively explore the teacher training program and teaching practicum in the PGCE Secondary English Programme at the University of Reading.

In case studies, documents are not the sole data collection tool. The variety of data collection methods can be employed to enrich the data in case studies (Grix, 2001). In the case study conducted in the United Kingdom, alongside the document analysis method, the interview method was also utilized. In the course of scrutinizing the documents pertaining to the teaching practicum of candidates enrolled in the PGCE English Secondary program at the University of [UR], the researcher diligently engaged in a process that culminated in the formulation of pertinent research inquiries. These questions were then posed to the faculty members during the conducted interviews. The durations of the interviews with the faculty members are presented in Table 2.

Table 2

Faculty Members Interviewed.

Faculty Member	Department	Face to face interview Duration	Online Interview Duration
Faculty Member 1	Head of School for the Institute of Education	2 hours	-
Faculty Member 2	Secondary English	2 hours	-
Faculty Member 3	Secondary English	-	1 hour
Faculty Member 4	Office of External Relations Education Unit	1 hour	-

Interviews with the faculty members were conducted at different appointment times and in their respective offices at the university. Only "Faculty Member 3" was interviewed online. The reason for this was the transition to remote education by universities in the UK, as in the rest of the world, due to the Covid-19 pandemic during the research phase. Employing a semi-structured interview approach, the investigator tailored the inquiries according to the inputs provided by the academic staff. The interviews were carried out in the English language, and the researcher took notes during the interviews. Additional sources and information that emerged from the faculty members' responses to the questions, as well as sources inaccessible to the researcher, were shared with the researcher via email by the faculty members. The primary objective underlying the conduct of interviews with esteemed faculty members resided in the aspiration to furnish additional elucidation and amplify upon the data acquired through the process of document analysis, a practice diligently carried out within the academic contexts of both Türkiye and the United Kingdom.

Furthermore, in accordance with the research aim, the external validity, defined as the authenticity and generalizability of all written, printed, visual, or electronic documents examined, and the internal validity, referred to as the semantic accuracy of the documents, were ensured (Kaptan, 2000).

Data Analysis

In this study, which utilized document collection and interview methods, data analysis was conducted in accordance with the defined objectives. Official documents containing information about teacher practicum were used as documents to describe both the situation in Türkiye and the situation in the UK. The data extracted from these documents underwent document analysis. In this study, data diversification was implemented through interviews in addition to document analysis. Yıldırım and Şimşek (2011) state that when the document analysis method is used alone, content analysis is employed. Moreover, it is worth noting that proponents of this approach contend that when document analysis is integrated with complementary data collection modalities, such as observational assessments and interviews, the need for intricate and convoluted data analysis procedures may be alleviated. This is predicated on the rationale that data derived from these supplementary methods can function synergistically to bolster and substantiate the findings derived from the examination of documents. In this context, descriptive analysis was conducted on the collected data in this study. During the data analysis, the information

related to teacher practicum from the institutions in the examined countries was addressed under separate headings for each country, and both similarities and differences were identified.

Guba and Lincoln, who emphasize the concept of credibility instead of validity and reliability in qualitative research, have identified the criteria for credibility in qualitative studies as believability, dependability, confirmability, and transferability (cited in Başkale, 2016). According to this framework, the credibility of the study can be explained as follows:

Believability: The researcher has had prolonged interactions with the data sources. The interaction with sources related to cross-country teacher practicum has been maintained throughout the 9-month period spent in both Türkiye and the UK. During this process, literature sources were extensively reviewed, and the accuracy of information obtained from documents during the stay in the UK was verified through conversations with teaching staff. Documents related to the comparative analysis of teacher practicums in Türkiye and the UK, as well as interviews with teaching staff in the UK, allowed for the collection of deeper and focused data. The use of both document analysis and interview methods for data diversification in the study enhances its credibility.

Transferability: In the context of this research, which assumes the form of a case study, a purposive sampling strategy was systematically employed. This strategic selection of samples entailed a meticulous examination of the contents encompassing teacher practicums conducted within the Department of Turkish Education at the Faculty of Education, Karamanoğlu Mehmetbey University, Türkiye, and the Department of Secondary School English Teaching at the University of [UR], United Kingdom. Therefore, data specific to a particular context was obtained, ensuring transferability. The data obtained from documents and interviews were presented to the readers without the researcher's interpretation.

Dependability: It can be stated that the research ensures dependability since the information obtained from documents and interviews is mutually corroborative and complementary.

Confirmability: The examined documents related to the topic are clearly indicated in the references.

Results

The results are presented in accordance with the formulated research inquiries.

Teacher Training Practicum in PGCE Secondary English Program in the UK

In order to teach in the UK, it is necessary to have the Qualified Teacher Status (QTS). The Teaching Regulation Agency (TRA), on behalf of the Deparment for Education, is the authorized body for the teaching profession in the UK. This agency is responsible for granting the QTS. Therefore, after successfully completing PGCE teacher training programs, teacher candidates are awarded the QTS certificate by this agency (Department for Education, 2023).

In the UK, the condition for teacher candidates to obtain the QTS certificate is to meet the standards set by the Department for Education known as the Teachers' Standards. The Teachers' Standards are used to assess all teacher candidates working towards QTS and qualified teachers who have completed their statutory induction period.

Additionally, they are also used to evaluate the performance of all QTS-qualified teachers who are subject to the 2012 Education (School Teachers' Appraisal) (England) Regulations. The Teachers' Standards define the minimum level of teaching practice expected from teacher candidates and teachers in terms of granting the QTS (Department for Education, 2021). Therefore, these standards serve as an assessment tool in the UK.

The Department for Education in the UK has formulated the Teacher Standards, which encompass two core domains: 'Teaching Standards' and 'Personal and Professional Conduct Standards'. The content of these standards is delineated as follows: (Department for Education, 2021):

Teaching Standards: • Fostering elevated expectations that stimulate, inspire, and challenge students. • Nurturing positive transformations and advancements in student growth. • Demonstrating proficient mastery of subject matter and curriculum. • Formulating and executing well-organized instructional sessions. • Tailoring pedagogy to cater to the diverse strengths and requirements of all students. • Employing assessments adeptly and proficiently. • Exercising adept behavior management to ensure an optimal and secure learning milieu. • Fulfilling broader professional obligations.

Personal and Professional Conduct Standards: • Teachers maintain public trust in the profession, upholding high ethical and behavioral standards both within and outside the school. • Teachers are expected to manifest a demeanor marked by respect and professionalism that aligns with the framework, policies, and procedures of the educational institution in which they are engaged. Besides, they are anticipated to uphold stringent criteria regarding their own consistency and punctuality. • Teachers should understand the legal frameworks that define their professional duties and responsibilities and always operate within these frameworks.

In the Teacher Standards document, the standards within the 'Teaching Standards' section have been further detailed and expanded through sub-items, providing more elaboration on the standards. Similarly, the first standard within the 'Personal and Professional Conduct Standards' has been elaborated and expanded. In the process of assessing the extent to which teachers align with established standards, it is imperative to underscore that comprehensive assessments carried out by educational institutions, both for teacher candidates and practicing educators, invariably incorporate the in-depth elucidations and expansions of these standards as integral components of the evaluation framework.

In the PGCE program of the Secondary English at the University of Reading's School of Education, teacher candidates are obligated to attend sessions consisting of 53 hours of instruction in 11 different subject areas within one academic year. The topics of these sessions are as follows: teaching reading and literature, teaching writing, teaching speaking and listening, teaching grammar and vocabulary, teaching poetry, teaching media in English, teaching Shakespeare, teaching and using drama in English, fostering creativity in English, adaptable teaching in English, and planning and assessment. In addition to these sessions, teacher candidates are required to engage in mandatory practical training in at least two schools for a minimum of 24 weeks, following the regulations set by the Teaching Regulation Agency in England, in order to qualify for the QTS certificate (University of Reading. (15. 05.2023). PGCE Secondary English. https://www.reading.ac.uk/ready-to-study/study/2023/education-pg/pgce-secondary-education-english).

The Teaching Regulation Agency (TRA) mandates the QTS certificate for teachers to be able to teach in state-funded primary schools, state-funded secondary schools, state-funded independent schools, and non-state-funded independent schools. State-funded schools belong to the publicly funded school system in England. Funding and oversight for these schools are typically provided by local authorities. Therefore, the teacher training practices for secondary school level native language teachers in the PGCE program of the University of Reading's School of Education, English Teaching Department, are planned in collaboration between the faculty and the partner practice schools.

The University of Reading's School of Education offers teacher candidates in all subjects of the Secondary school Level Postgraduate Teacher Training (PGCE) program the opportunity to complete internships in approximately 90 schools in the local and surrounding areas at the secondary school level. The university's extensive range of experiences allows teacher candidates to establish connections with potential employers and build a professional network (University of Reading. (15. 05.2023). PGCE Secondary English. https://www.reading.ac.uk/ready-to-study/study/2023/education-pg/pgce-secondary-education-english).

Additionally, in the PGCE program of Institution of Education at the University of Reading, Secondary school English Teacher candidates are required to complete internship practices in two different age groups and three different institutions. In the context of the teaching practicum, it is imperative to emphasize that a mandatory stipulation necessitates the inclusion of two educational institutions that have received formal designation by the Teaching Regulation Agency as prescribed entities for the execution of this pedagogical training component. However, as a third institution, alternatives such as museums, charities, independent schools, or special education schools are preferably offered to the candidate teachers as a different option.

In teacher training practices in the UK, teacher candidates are engaged in actions such as observing other teachers, planning instruction for different class groups, preparing and designing teaching materials, self-assessment, receiving feedback from the practicing teacher, and gaining experience under the mentor teacher's guidance in schools (University of Reading. (15. 05.2023). PGCE Secondary English. https://www.reading.ac.uk/ready-to-study/study/2023/education-pg/pgce-secondary-education-english).

In the PGCE program of the Department of Secondary school English Education at the University of Reading, teacher candidates are evaluated by mentor teachers three times during their teaching practice period, which must be carried out in at least two schools and for a minimum of 24 weeks on a full-time basis. This evaluative process adheres to the criteria set forth by the Department for Education, encompassing the rigorous assessment in accordance with the Teacher Standards prescribed by the same authority. Based on the standards expressed in the subheadings of these specified standards, teacher candidates are scored by mentor teachers as excellent, satisfactory, developing, or failing, based on their level of achievement.

Figure 1

A section from the Assessment Scale of the PGCE Secondary English Program for Trainee Teachers at the University of Reading Institute of Education

Figure 1 displays a section from the Assessment Scale of the PGCE Secondary English Program for Trainee Teachers at the UR Faculty of Education. The scale was obtained through the institution's teaching staff. The scale is in Excel format and consists of six sections: Frequently Asked Questions, Attendance List, 1st Report, 2nd Report, 3rd Report, and Summary. Each report expects the mentor teacher to evaluate the trainee teacher according to the Teacher Standards. Trainee teachers are also required to provide explanations about the goals they will set based on the mentor teacher's evaluations. Additionally, in each report, the mentor teacher and trainee teacher evaluations guide the teaching staff in making an overall assessment. Concurrently with these evaluative procedures, prospective educators are required to compile a comprehensive portfolio that serves as a tangible manifestation of their fidelity to national standards, thereby substantiating their proficiency and competence within the pedagogical realm. Trainee teachers who are determined to have met all standards as a result of their teaching practice are reported to the Teaching Regulation Agency by the university and become eligible to receive the Qualified Teacher Status (QTS) certificate required to become a qualified teacher.

Teaching practice in secondary school native language teacher training programs in Türkiye

In the context of Türkiye, the practical component of teacher training is executed within educational establishments, both public and private, that are under the auspices of the Ministry of National Education [MNE]. Individuals enrolled in education faculties, Pedagogical Formation Certificate Programs, and Non-Thesis Master's Programs specializing in Teaching Profession Knowledge are tasked with the responsibility of completing the teaching practicum course (MNE, 2021). The Turkish language teaching program, situated within the domain of secondary school-level subject teacher training, is systematically administered within faculties of education. Notably, participants enrolled in this program, who are prospective educators specializing in Turkish language instruction, undertake their requisite teaching practicum in educational institutions affiliated with the Ministry of National

Education (MNE). This alignment is intrinsic to the program's inherent nature and its established pedagogical protocols.

The MNE describes teaching practice as follows in the Official Gazette (2021): The teaching practicum takes place over the course of a full academic year, spanning a minimum of two terms. The fall and spring terms are each organized with a duration of 12 (twelve) weeks, and a weekly workload of 6 (six) teaching hours. Teaching practice consists of a total of 144 (one hundred and forty-four) teaching hours for each term, with 72 (seventy-two) hours per term. The trainee teachers, under the supervision of the practice teacher, actively teaches lessons during at least 8 (eight) different weeks throughout each term. In courses with 1-2 teaching hours per week, the trainee teacher teaches for at least 10 (ten) hours, while in courses with 3 (three) or more hours, they teach for a minimum of 20 (twenty) hours.

In secondary schools, since Turkish language classes are 5 hours, the responsible teaching practice for the Turkish Language Teaching undergraduate program is also at least 20 hours in accordance with the directive. As outlined by the curriculum established by the Turkish Council of Higher Education, the teaching practice component within the Turkish Language Teaching program is scheduled during the seventh and eighth semesters. The content of the Teaching Practice course is specified in the program identically for both terms. The Teaching Practice module constitutes a 5-credit course encompassing 2 hours of theoretical instruction and 6 hours of practical application, and since it is taught for two terms, it totals 10 credits. Throughout both semesters, the curriculum of the course is structured around the following components: observation of field-specific specialized teaching methods and techniques, implementation of micro-teaching sessions utilizing field-specific specialized teaching methods and techniques, autonomous lesson planning, creation of lesson-related activities and materials, arrangement of teaching settings, classroom management, assessment, evaluation, and reflective practices (CHE, 2018). During this process, prospective educators collaborate with supervising academic staff within the university. They also work with on-site practicing instructors at affiliated educational institutions.

In partnership with the provincial directorate of national education and in consultation with the administrators of potential practice training institutions, the selection of practice training institutions and the allocation of trainee teacher slots for each institution, based on their type and level, are coordinated. The quota is set based on the teaching fields, with a maximum of 6 (six) students per practice teacher and a maximum of 12 (twelve) students per practice instructor. For each practice teacher, the number of students per class is also planned not to exceed 3 (three) students per class (MNE, 2021).

Teaching practice is conducted in official educational institutions and private educational institutions located within the province where the relevant higher education institution is located. Students from various classes, fields, and guidance participate in the practice at educational institutions. Some parts of the teaching practice can be carried out in educational institutions in rural areas. At KAEU Faculty of Education, within the Turkish Language Teaching department, teaching practice takes place in schools designated in the city center. As part of this course, teacher candidates are expected to create a portfolio in which they compile their experiences into reports. The assessment of

teacher candidates' achievements is carried out by the responsible faculty member and the consulting practice teacher (MNE, 2018).

Teacher candidates' performance is independently assessed by the practice supervisor, the supervising teacher, and the head of the practice school. The evaluation of the teacher candidate's performance during the teaching practice is synthesized into a grade by integrating assessments provided by the practice supervisor, the supervising teacher, and the principal of the practice school, in accordance with the guidelines outlined in the "Regulation on Education, Teaching, and Examination" of the faculty. The final evaluation is determined by the practice supervisor's conclusive assessment. The grades given by the practice instructor are submitted to the faculty administration (Kırşehir Ahi Evran University Faculty of Education, 2018).

The practice teacher evaluates the lessons that the trainee teacher has actually taught, at least twice, one of which is for the first taught lesson and the other for the last taught lesson. The practice teacher enters this evaluation into the Trainee teacher Evaluation module of the MNE Information Systems (https://uod.meb.gov.tr). The Ministry of National Education Trainee teacher Evaluation module includes two types of evaluations: daily and overall assessments. After the daily evaluation by the practice teacher, the practice instructor also conducts an evaluation. In a customary manner, teacher candidates are assessed using a consistent module at the culmination of both the inaugural and subsequent semesters within the academic year.

Figure 2 includes a section from the assessment scale of the teaching practice course of the Turkish Language Teaching Program at KAEU Faculty of Education. However, this assessment scale is not exclusive to teacher candidates in the Turkish Language Teaching Program at KAEU Faculty of Education; it serves as an electronic assessment tool for all teaching practices conducted under the Ministry of National Education (MNE) in Türkiye. The scale under the scope of the study is presented as an example specifically under the title "KAEU Faculty of Education Turkish Language Teaching Program." The section shown in the figure is a segment from the general evaluation part of the practice instructor. Both daily and overall evaluations conducted in electronic form are assessed by the practice instructor and the cooperating teacher under different headings. The assessment methods include both open-ended and Likert-type questions in both daily and overall assessments. In the Likert-type assessment, criteria are defined under categories such as insufficient, acceptable, and well-prepared according to the topic titles.

Figure 2

A Section from the Daily Teaching Practice Evaluation Scale of the Turkish Language Teaching Program at Kırşehir Ahi Evran University Faculty of Education.

Üniversitesi	: Kırşehir Ahi Evran Üniversitesi		Öğrenci Sayısı	: 31
Fakültesi	: Eğitim Fakültesi		Tarih	: 12/04/2023
Bölümü	: Türkçe Öğretmenliği Pr.		Konu	: Cümle Anlamı (Sitem ,Hayıflanma İhtimal...)

Uygulama Öğretmeni

Ölçüt	Soru	Soru Metin	Puan	
Konu Alanı Bilgisi	1	1.1.1 Konu ile ilgili temel ilke ve kavramları bilme	3.000	İyi Yetişmiş
	2	1.1.2 Konuda geçen temel ilke ve kavramları mantıksal bir tutarlılıkla ilişkilendirebilme	3.000	İyi Yetişmiş
	3	1.1.3 Konunun gerektirdiği sözel ve görsel dili (şekil, şema, grafik, formül vb.) uygun biçimde kullanabilme	3.000	İyi Yetişmiş
	4	1.1.4 Konu ile alanın diğer konularını ilişkilendirebilme	3.000	İyi Yetişmiş
Alan Eğitimi Bilgisi	5	1.2.1 Özel öğretim yaklaşım, yöntem ve tekniklerini bilme	3.000	İyi Yetişmiş
	6	1.2.2 Öğretim teknolojilerinden yararlanabilme	3.000	İyi Yetişmiş
	7	1.2.3 Öğrencilerde yanlış gelişmiş kavramları belirleyebilme	3.000	İyi Yetişmiş

During the daily assessment process, the supervising instructor offers personalized viewpoints within the following categories of "command over subject domain knowledge and pedagogy, acquaintance with students and student interaction, establishment of conducive learning settings, adeptness in evaluating student progress, lesson design and execution, professional demeanor, and value-based approach." Conversely, the collaborating educators assess proficiencies under the domains of "command of subject-specific knowledge, pedagogical competence, instructional methodology, classroom management at lesson outset, classroom management during instruction, classroom management as lesson concludes, and communicative prowess," employing a Likert-type scale. The overall evaluation by the practice instructor assesses the teacher candidate using a Likert-type scale in terms of subject matter knowledge, subject education knowledge, and planning. Additionally, it provides additional comments based on topic headings related to the teacher candidate, just like in the daily assessment. On the other hand, the cooperating teacher conducts a general assessment using a Likert-type scale, considering teaching process, classroom management, communication, assessment and record keeping, and other professional competencies.

Teacher candidates are also evaluated based on their performance in the teaching practice course, which is considered a separate course within education faculties. Additionally, the grades from this course are reflected in their overall academic performance. The assessment of the teaching practice at the faculty level is conducted through consultation and collaboration between the practice instructor and the supervising teacher.

Discussion, Conclusion & Suggestions

This research aimed to conduct a comparative analysis of the teaching practice experiences of prospective secondary school native language teachers in the United Kingdom and Türkiye. Through interviews conducted to supplement the findings from UK documents and the examination of relevant documents from both countries, we identified similarities and differences in terms of teaching practice in native language teacher training programs.

In the UK, institutions that provide teacher education exhibit diversity, and consequently, teacher training practices can also vary. This study specifically evaluates the PGCE certificate program and university-based teacher

training practices within the context of the Reading University School of Education's PGCE program for secondary school English teaching. Although teacher training programs in the UK can be diverse, teachers are required to possess Qualified Teacher Status determined by the UK Department for Education. To achieve this status, teacher candidates must meet the standards outlined in the Teachers' Standards during their teaching practice. The evaluation criteria for teaching practice are aligned with these standards.

Similarly, in Türkiye, institutions providing teacher education show diversity, and prospective teachers for primary and secondary school levels are educated at the undergraduate level in faculties of education. Teaching practice within education faculties in Türkiye follows the curriculum set by the CHE . The examined institution, KAEU Faculty of Education's Turkish Language Teaching program, represents secondary school Turkish language teaching programs in Türkiye. The results obtained from the research can also be evaluated in this context.

When comparing the durations of teacher training practices in both countries, it can be observed that the duration of practice is 24 weeks for both countries. However, in Türkiye, according to the MNE (2021) guidelines, teacher training practices are conducted either for one full day or two half days per week. Depending on the curriculum status of Turkish lessons at the secondary school level, Turkish language teacher candidates complete 40 hours of teaching practice within two terms. On the other hand, in the UK's PGCE program for training secondary school native language teachers, a mandatory full-time teacher training practice of 24 weeks is required. When comparing the practice hours in the two countries, it can be said that the duration of teacher training practice in Türkiye is shorter than that in the UK. This conclusion is consistent with OECD (2014) data as well.

From the perspective of practice schools, there are also differences between the two countries. In the UK, there is a requirement to complete teacher training practice in at least two different schools. Additionally, at Reading University, third-party institutions such as museums and charities are offered as alternative options for teacher candidates. In Türkiye, the schools for practice are determined as state schools and private schools under the MNE. In the UK, the opportunity for teacher candidates to conduct practice in institutions other than formal educational institutions provides them with a richness of experience from various contexts.

When comparing the evaluation of teacher training practices between the two countries, differences can be observed. In the UK, teacher candidates are evaluated according to teacher standards. Despite differences in teacher training institutions, all institutions must ensure that their teacher candidates meet these standards. Additionally, practicing teachers who are already in the profession are also evaluated based on these standards. However, this evaluation is not conducted electronically through a common information system but rather through assessment tools developed by individual institutions. In Türkiye, the evaluation of teacher training practices is conducted both within the faculties and within the MNE. The evaluation carried out by the Ministry is done through the Teacher Training Application Evaluation Portal of the MNE's Information System. This way, the evaluations are collected within the ministry through electronic means.

In conclusion, teacher training practices for institutions educacting secondary school native language teachers in Türkiye and the UK differ in terms of content, practice hours, school diversity, and evaluation methods. These findings contrast with the results of Çakmakçı and Demir's (2021) study on the evaluation of teacher training

practices for native language teacher candidates in Türkiye and Finland. As Köse and Caner (2022) have also pointed out, conducting studies that include teacher training practices and perform cross-country comparisons will contribute to teacher education in Türkiye.

Ethic

This study adhered to all guidelines stipulated by the "Council of Higher Education Scientific Research and Publication Ethics Directive." No actions outlined in the section titled "Actions Contrary to Scientific Research and Publication Ethics," which constitutes the second part of the directive, were undertaken.

Author Contributions

The author has prepared the article alone.

Conflict of Interest

In the research, there are no situations or relationships that could constitute a conflict of interest for the author.

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Parental Competence, Parenting Stress, Family Harmony, and Perceived Available Support among Mothers with Children Aged 3-6 Years

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Abstract

There is a growing body of research focused on examining family dynamics. This article reports on two studies. Study 1 aimed to develop a parental competence scale and examine its psychometric qualities. Data was gathered from 915 Turkish mothers with children aged 3-6 years. In order to evaluate the instrument's internal structure, exploratory (EFA) and confirmatory factor analyses (CFA) were performed. EFA revealed that there was a single factor structure consisting of 13 items. CFA confirmed that all items in the one-dimensional scale are compatible with the model and goodness of fit values were acceptable. Reliability analyses showed that the scale's internal consistency was high. Study 2 aimed to investigate the direct and indirect effects of parenting stress on parental competence and family harmony through the perceived available support. Data was obtained from 261 mothers with children ages 3-6 years. The results of the study revealed that the perceived available support not only mediated the relationship between parenting stress and parental competence, but also the relationship between parenting stress and family harmony. Findings were discussed in light of family dynamics literature.

Key Words

Family harmony • Mothers • Parental competence • Parenting stress • Perceived available support

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Introduction

Becoming a parent is an inherently transformative experience that brings about a multitude of novel physical, social, psychological, and financial responsibilities (Deater-Deckard, 1998; Vance & Brandon, 2017). The experience of sharing and fulfilling child-related responsibilities can often be stressful for many parents (Abidin, 1990; Anthony et al., 2005; Wang et al., 2023). Especially, meeting a preschool child's physical, mental, and emotional needs is one of the most critical responsibilities parents have throughout the family life cycle (Gladding, 2015). During this period, significant developments occur in the child's emotional, social, cognitive, linguistic, and motor abilities and parents have a crucial role in the acquisition of these skills (Ruiz-Zalibdar et al., 2018) and in the promotion of a sense of autonomy and competence in their child (Erikson, 1977). Nevertheless, it is also important for parents to cultivate their own sense of competence as caretakers (Gladding, 2015). Over time, some parents experience a growing sense of competence in addressing their children's needs, whilst others hold concerns over their ability to fulfill these responsibilities competently. The society in which individuals live is also important in this kind of self-reflection. Since parenting is a social role influenced by societal values, beliefs, traditions, and norms produced by the macro system (Bronfenbrenner, 1977; Kagitcibasi, 2005; 2017; Pearlin, 1989), individuals experience stress or tension when they encounter challenges and difficulties associated with their roles and responsibilities. As the primary caregiving responsibility for children often falls on mothers in many societies (Ecevit, 2010), the sense of responsibility they feel may lead them to question their own parenting competence and efficacy. Thus, mothers may feel more stressed about these responsibilities (Berryhill, 2015), and need to empower themselves with available social support resources (Belsky et al., 1984). In other words, mothers may need to build strong relationships with social support resources for managing their stress related to parental responsibilities, increasing their competence and creating a harmonious family system. To gain a deeper understanding of these family dynamics, the current study aimed to investigate the links between parenting stress, parental competence, family harmony, and perceived available support among mothers with early childhood children in the Turkish cultural context.

Parental Competence

A growing body of research in the field of family psychology indicates that child-rearing is an experience in which parents are concerned with their self-efficacy and competence. Although the concepts of parental self-efficacy and parental competence sometimes overlap in the literature because of their link with parental confidence in parenting abilities, some studies have shown that there are some nuances between them (Hess et al., 2004; Montigny & Lacharité, 2005; Sabatelli & Waldron, 1995). One of the nuances between them becomes apparent concerning the theoretical foundations. While parental self-efficacy is generally based on the self-efficacy theory (social cognitive theory) (Bandura, 1994, 1997), parental competence is mostly grounded in attachment theory (Bowlby, 1982; Teti & Candelaria, 2002) and parenting styles (Baumrind, 2005; Maccoby & Martin, 1983). An additional nuance emerges when considering the definitions of these concepts. In the extant literature, it is seen that the concept of parental self-efficacy is generally defined as "the degree to which the parent feels competent and confident in handling child problems" (Johnston & Mash, 1989, p. 167), "beliefs or judgments about one's competency or ability to be

successful in the parenting role" (Hess et al., 2004), and "the expectation caregivers hold about their ability to parent successfully" (Jones & Prinz, 2005, p. 342). Similarly, it is observed that parental competence is generally conceptualized as the "practical ability of parents to nurture, protect and educate their children, ensuring their sufficiently healthy development" (Barudy & Dantagnan, 2010, p. 34, cited by Reparaz et al., 2021). Another nuance arises based on the measurement of these concepts. According to Vance and Brandon (2017), parental self-efficacy is measured using self-reporting based on subjective perceptions. On the other hand, parental competence is measured through both parental self-reports and objective assessments or observations made by third parties (teachers, friends, etc.). It consists of key components such as warmth, acceptance, and sensitivity towards the child's basic needs, social cues, and appropriateness in line with his/her level of development (Teti & Candelaria, 2002). In the present study, the term of parental competence is favored for indicating the sense of confidence pertaining to parental ability and skills. This choice was influenced by the fact that the scale used to measure this psychological construct was designed to encompass both parents' and external parts'(such as teachers') expectations of a competent parent.

A comprehensive analysis of the existing body of literature demonstrated that studies on parental competence have focused on both different stages of the life cycle, including childhood (Townshend et al., 2016; Windhorst et al., 2019), adolescence and emerging adulthood (Dittman et al., 2016; Huey et al., 2020) and different stages of the family life cycle. In these studies, parental competence has been associated with numerous personal and relational outcomes (Jackson & Moreland, 2018). For instance, some studies have reported that higher levels of parental competence are linked with some personal outcomes such as well-developed coping skills, increased levels of general well-being (Steele et al., 2020) and emotional well-being, lower levels of stress, anxiety, and depression (Ho & Liang, 2021), higher levels of well-being, and positive mental health (Albanese et al., 2019; Ho & Liang, 2021; Osman et al., 2017). Other studies indicated that increased parental competence has been associated with some parental outcomes, such as effective parenting practices (Gilmore & Cuskelly, 2008), and parent-child relationships (Lamb, 1976). In this study, we focused on the parental competence of mothers in the stage of family with a young child in the family life cycle and examined the parental competence's relationship with both a personal outcome (parental competence) and a relational outcome (family harmony).

Family Harmony

Family harmony is a concept that refers to "people's balanced and well-aligned life with family members and friends, with the living environment, and with themselves (in terms of physical and mental health), as well as having a balanced family-work life, permeated with the benefits of mutual support and flourishing" (Ip, 2014, p. 737). It is one of the fundamental features of family relationships in collectivist societies and differs from the concept of family support, which is one of the healthy family functions in individualist societies, by emphasizing responsibilities towards the family (Oyserman et al., 2002). For instance, family harmony has a crucial place as a fundamental Confucian principle within Chinese society, since it is often considered an essential component in a family's overall well-being and happiness (Lam et al., 2012). It is also associated with greater parental warmth and less parental control (Lau et al., 1990). Similarly, in Turkey, a country with a collectivist cultural structure (Hofstede, 2001), it has been determined that family harmony is one of the predictors of happiness (Demirci, 2022) and life satisfaction

(Duman-Kula et al., 2018). In these collectivist cultures, family harmony is considered a protective/risk factor for mental health and well-being (Duman-Kula et al., 2018; Kavikondala et al., 2016). It has also negative associated with parenting stress (Keller & Honig, 2004). The presence of family harmony and less conflict within the family system contributes to an enhanced capacity to get pleasure from enjoyable experiences, heighten overall life satisfaction, and lessen symptoms of depression (Cheung et al., 2020). This study focused on family harmony as an outcome variable and the effect of parenting stress on it.

Parenting Stress

Parenting stress is characterized by the experience of negative emotions by parents towards themselves and their children, with these unpleasant feelings being attributed to the demands and responsibilities associated with being a parent (Deater-Deckard, 1998; Teti et al., 1991). Abidin (1990) posited that parental stress is influenced by a complex interaction of three primary stressors: factors related to the parent, the child's specific qualities, and contextual factors. The present study focused on the factors associated with parents. The extant literature indicated that many couples transitioning into the family with a young child stage of the family life cycle want to adapt to the parenting identity and feel that they fulfill the parenting role effectively and competently (Gladding, 2015). However, due to rapid and significant social, economic, and technological developments, they face several problems, ranging from displaying practical and effective parenting skills to providing various resources or opportunities for their children. These difficulties place pressure and stress on parents (Bandura, 2009). Some factors, such as a large number of children (Hong & Liu, 2021), low income, inadequate social support, being single parent (Evans et al., 2008; Oddi et al., 2013) can increase this stress, while others such as adequate social support (Cohen & Wills, 1985; Manuel et al., 2012; Raikes & Thompson, 2005) reduce it. Previous research has shown a correlation between increased levels of parenting stress and many negative outcomes, including parental depression (Huang et al., 2014), separation anxiety (Deater-Deckard et al., 1994), a lower quality of life (Hsiao, 2018), sleep problems (McQuillan et al., 2019), and parental physical health problems (Hildingsson & Thomas, 2014). In addition, it was found that the perception of parental stress is influenced by gender, specifically highlighting that mothers of preschool children tend to perceive higher levels of parental stress than fathers (Skreden et al., 2012). From this point of view, we determined parenting stress as a predictor of parental competence and family harmony in this study.

Perceived Available Support

Bronfenbrenner's (1977) ecological perspective has posited that parents require social support resources to carry out their parental responsibilities effectively. Perceived available support refers to an individual's perceived capacity to obtain social support, and it is the recipient's subjective assessment of the likelihood of receiving assistance - emotional, informational, and practical - from their social network, including their friends, partners, family, and other relatives, in times of need (Cobb, 1976; Freeman et al., 2011). It includes both structural and functional components of interpersonal interactions, which have been measured for quantity and satisfaction. Social relationships and their links are structural characteristics of social support. The functional aspects of interpersonal relationships are the specific functions they serve. Functional support may be categorized into two distinct types: *perceived available support* and *support actually received* (Wethington & Kessler, 1986; Wills & Shinar, 2000). The concept of *received*

support refers to the distinct acts of help offered by individuals such as friends, family members and partners. In other words, it relates to an individual's impression of being valued and respected by others (Wethington & Kessler, 1986). The support recipient's subjective perception that friends, family, partners, etc. would help if required is called *perceived available support* (Barrera, 1986; Uchino, 2009). According to this conceptualization, the presence of a perceived sense of being cared for has the potential to positively influence one's health, regardless of the accuracy of this impression (Cobb, 1976). Similarly, research has suggested that parents who get higher levels of perceived emotional and instrumental support from their partners, family members, and friends have lower levels of parenting stress (Abidin & Brunner, 1995; Ostberg & Hagekull, 2000; Roggman et al., 1994) and greater levels of parental satisfaction (Carter et al., 2017). In this sense, social support has been identified as a protective factor against parental stress (Sharda et al., 2019). However, a dysfunctional familial atmosphere increases stress and provides less support for members, challenging mental health (Kavikondala et al., 2016). Based on these findings, perceived available support was determined as a mediator variable in this study.

Rationale and Purpose of the Study

The current study was conducted with two objectives. The purpose of Study 1 was to develop a new scale of parental competence for mothers with children aged 3 to 6 years. The scale aimed to measure the extent to which mothers feel competent in developing their children's emotional, social, and intellectual skills, ecological sensitivity, interests, and abilities. Although there are various psychological instruments to measure parental competence in the existing literature, the most widely used tool is the Parenting Sense of Competence Scale (PSOC) developed by Gibaud-Wallston, and Wandersman (1978). The psychometric properties of the PSOC that consists of 16 items and two dimensions, skill-knowledge and value-comforting, have been re-examined in a study conducted with Canadian mothers and fathers of children aged 4 to 9 years by Johnston & Mash (1989) and its sub-dimensions were renamed as satisfaction and efficacy. This scale was also adapted into Turkish by Cokamay Yılmaz (2018) and has been widely used in Turkey. However, recent studies show that the factor structure of the PSOC still needs to be improved (Gilmore & Cuskelly, 2008). As the family system and parenting are primarily formed based on culturally constructed roles and responsibilities and are developmentally sensitive (human lifecycle and family lifecycle), Study 1 aimed to assess parental competence using a psychological tool that is both culture-specific and responsive to development.

To develop a deeper understanding of the role of parenting stress on family life, Study 2 aimed to examine the direct and indirect effects of parenting stress on a personal outcome namely parental competence and a relational outcome namely family harmony via perceived available support (Figure 1). Social resources, or social support, are just as important as personal resources for coping with stress. Previous research has shown that parental stress (Deater-Deckard, 1998; Jackson & Huang, 2000; Webster-Stratton, 1998) and social support (Belsky et al., 1984) have a significant impact on parental competence, and parenting stress is also linked to family harmony (Keller & Honig, 2004). To the best of our knowledge, the relationships between parental stress, parental competence, family harmony, and perceived available support have not been examined together. This study would expand the extant literature to explore the relationships among these psychological structures.
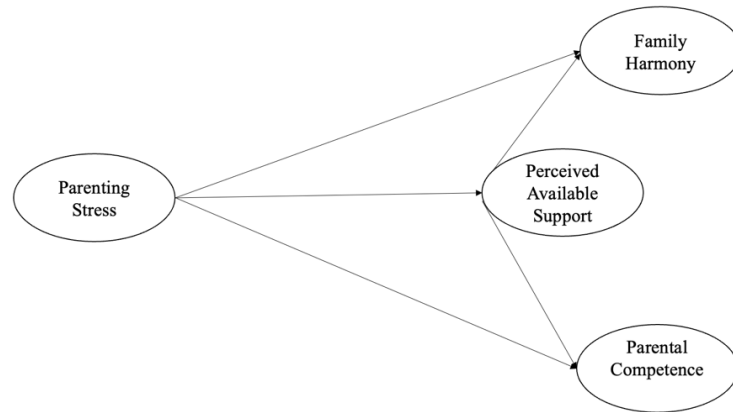
Figure 1. Tested model

Method

This research consisted of two parts, Study 1 and Study 2. The purpose of Study 1 was a scale development study to measure parental competence. The purpose of Study 2 was to establish and test a structural equation model to examine the relationships between perceived available support (PS), parenting stress (PST), family harmony (FH) and parental competence (PC).

Study Group for Study 1 and Study 2

In Study 1, a total of 915 mothers who had children aged between 3 and 6 were reached. In Study 2, a total of 261 mothers were recruited. The study group comprised a total of 1,176 mothers. The number of individuals for each stage is given in Table 1.

Table 1

Working groups for Study 1 and Stıdy 2

Study groups	Scales	Statistical Procedures	N
Study 1	Parental Competence Scale	EFA for construct validity and Cronbach's alpha and McDonald's omega for internal consistency	473 mothers
	Parental Competence Scale	CFA for construct validity	442 mothers
Study 2	Family Harmony Scale - Short Form, Parent Stress Scale, Perceived Available Support Scale, Parental Competence Scale	Structural equation model (SEM) for model testing	261 mothers

While forming the study group, it was tried to reach maximum diversity in terms of age, education level and number of children. In the group of 1,176 mothers, 49% were between the ages of 30 and 34, 23.4% were between the ages of 25 and 29, 20% were between the ages of 35 and 39, 6.1% were between the ages of 40 and 44, and 1.5% were between the ages of 20 and 24. Besides that, 62.7% of mothers have a bachelor's degree, while 15% have a high school diploma, 11.5% a graduate degree, 4.4% a secondary school diploma, 2.7% an associate degree, 2.2% a doctoral degree, and 1.5% a primary school diploma. More than half of mothers (51.5%) have two children, while 28.5% have one, 15.4% have three, 3.3% have four,.8% have five, and 0.5% have six.

Research Instruments and Data Analysis for Study 1

Within the scope of Study 1, the Parental Competence Scale (PCS) was developed. The scale items were created based on both a comprehensive review of the existing literature on parental competence and informal meetings with mothers of 3-6-year-old children and teachers working with children in this period. Thus, the Parental Competence Scale was grounded in theory and practice, and a total of 23 items were generated. This item pool was assessed by four specialists in assessment and evaluation, psychological counseling, preschool education, and the Turkish language. Consistent with experts' viewpoints, five items considered inappropriate for the original intent of the scale were removed, resulting in the development of a final trial version consisting of 18 items. The answer format for the scale items was a five-point Likert scale. *(1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Always).*

To assess the construct validity of the scale in the context of validity studies, exploratory factor analysis (EFA) was conducted as the initial step. Principal-axis factor analysis was used due to its reputation as one of the most effective methodologies for understanding the underlying structure of the items (Costello & Osborne, 2005). First, the KMO value was interpreted within the context of factor analysis. As the KMO value approaches a value of 1, it is regarded to be excellent, and above .70 is considered sufficient. The scree plot graphics and factor loadings were examined to determine the appropriate number of factors and select items to be incorporated into the scale. It was ensured that the minimum factor loading was .32. (Kline, 2011; Tabachnick & Fidell, 2007). After determining the number of factors and selecting items to be included in the scale, the statistical analysis of the remaining items was conducted. This analysis involved calculating the item-total test correlation and examining the differences in mean scores between the lower and upper groups, which comprised 27% of the sample. The lowest value for the item-total test correlation is expected .30, and the difference between the item mean scores of the 27% lower and upper groups is anticipated to be statistically significant. Significant t-values for differences between the lower and upper groups are regarded as evidence of the item's discrimination (Erkuş, 2012). The reliability of the scale's results was assessed by performing Cronbach's alpha coefficient and McDonald's omega.

Confirmatory factor analysis (CFA) was performed following the release of the scale's structure and reliability. The CFA method is used to determine the degree of association between observable variables and their latent constructs (Jöreskog & Sörbom, 2001). The unidimensional structure identified in the EFA was further examined using CFA and assessed using goodness-of-fit statistics. In this context, the following statistical measures were reported in this study: Chi-square to degrees of freedom ratio ($\chi2/df$), Root Mean Square Error of Approximation (RMSEA), 90 Percent Confidence Interval for RMSEA, Normed Fit Index (NFI), Non-Normed Fit

Index (NNFI), Parsimony Normed Fit Index (PNFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Relative Fit Index (RFI), Root Mean Square Residual (RMR), Standardized RMR, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Parsimony Goodness of Fit Index (PGFI) values (Hu & Bentler, 1999; Kline 2011; Şimşek, 2007; Tabachnick & Fidell 2007; Thompson 2004). Additionally, the t-values of the items were examined. Items in the model that possess t-values above 1.96 and demonstrate statistical significance ($p < .05$) suggest that these items are consistent with the model and must be kept in the scale.

Research Instruments and Data Analysis for Study 2

Data was gathered using the Family Harmony Scale - Short Form, the Parental Competence Scale, the Parent Stress Scale, the Perceived Available Support Scale and the demographic information sheet.

Family Harmony Scale - Short Form. The Family Harmony Scale – Short Form developed by Kavikondala et al. (2015) to measure family harmony consists of five items (e.g., *"I am proud of my family."*). It is responded to on a 5-point Likert-type rating form *(1 = Strongly disagree, 5 = Strongly Agree).* Higher scores on the scale indicate higher family harmony. It was determined that the scale had a single-factor structure and fit data well in the original study. The Cronbach's alpha reliability coefficient of the scale was calculated as .92. The scale was adapted to Turkish culture by Duman Kula et al. (2018) and the Cronbach's alpha coefficient was calculated as .91. In the present study, both Cronbach's alpha and McDonald's omega were computed as .92.

Parental Competence Scale. The Parental Competence Scale was developed by the researchers of this study to measure the extent to which mothers feel competent in developing their children's emotional, social, and intellectual skills, ecological sensitivity, interests, and abilities. It consists of 13 items (e.g., *"I prepare environments for my child that support their existing abilities.", "I provide opportunities for my child to develop different interests"*) scored on a 5-point Likert-type rating form. Higher scores on the scale indicate higher parental competence. The validity and reliability findings of the scale were reported in the findings section of this study.

Parent Stress Scale. The Parent Stress Scale (Kaymak Ozmen & Ozmen, 2012) is a tool for assessing the stress that parents experience as a result of their daily interactions with their children. The scale is comprised of a single-factor structure. The 16-item scale (e.g., *"The main source of stress in my life is having a child."*) is scored on a 4-point Likert-type rating form *(Never = 1, Always = 4).* High scores on the scale indicate higher levels of parenting stress. In the original study, the Cronbach's alpha internal consistency reliability value of the scale was calculated to be .85. In the present study, both Cronbach's alpha and McDonald's omega were computed as .91.

Perceived Available Support Scale. The Perceived Available Support Scale developed by Schulz and Schwarzer (2003) is a part of the Berlin Social Support Scales. It measures perceived emotional and instrumental support. The scale consists of 8 items (e.g., *"Whenever I am sad, there are people who cheer me up."*) and two sub-dimensions, namely emotional support and instrumental support, and is scored on a 5-point Likert-type rating form. Cronbach's alpha reliability coefficient was calculated as .83 for the overall scale in the original scale development study. The scale was adapted to Turkish culture by Kapkiran & Kapkiran (2010). Cronbach's alpha values were calculated as α = .88 for the overall scale, α = .80 for the emotional social support subscale, and α = .83 for the instrumental social

support subscale in the adaptation study. In the present study, both Cronbach's alpha and McDonald's omega were computed as .94.

In Study 2, it was examined the mediating role of perceived available support in the relationship between parenting stress and both family harmony and parental competence. This analysis was run using the LISREL 8.51 program. The maximum likelihood is used as the estimation method, considering the probability of being affected by the sample size and distribution of the fitted values is less than with other methods (Hu & Bentler, 1998). The measurement model was first estimated before the structural model was performed. The measured variables for perceived available support, parenting stress, and parental competence were generated using sum scores of subfactors for each latent construct and parcel. Item parceling is a method for normalizing the distribution of indicators and increasing their reliability. For each latent variable, indicators as parcels were constructed by rank-ordering the items by the size of the item-total correlation and summing the sets of items to obtain equivalent indicators for those constructs (Little et al., 2002). Since family harmony is a five-item scale, the parcel was not created. The parenting stress and parental competence constructs were defined using item-parceling because they only contain a single factor. The operationalization of the perceived available support variable was based on the sum of the subfactor scores for emotional support and instrumental support. The normality of the variables were tested using skewness and kurtosis values. Obtained values were less than .97, ranging from -.09 to -.92 for skewness and from .10 to .97 for kurtosis, demonstrating that variables are normally distributed in the sample.

Bootstrap analysis was performed to examine the mediation role of perceived available support in the relationship between parenting stress and both family harmony and parental competence. Testing the role of mediator variables with bootstrapping and determining whether indirect paths are nonzero strengthens the testing of the established model (MacKinnon et al., 2002; Shrout & Bolger, 2002). This analysis was carried out at a 95% confidence interval and the number of bootstrap samples was adjusted to 5000. The absence of a "0" value between lower (BootLLCI) and upper (BootULCI) bootstrap values has been interpreted as indicating that the effect of the mediator variable is statistically significant (Hayes, 2018).

Results

Study 1

Structural Validity

EFA and CFA were utilized to assess the construct validity of the scale results. During the first stage, the scale comprising 18 items was administered to 492 mothers. The principal-axis factor analysis was conducted on a sample of 473 mothers, after excluding 19 extreme values before the analysis. The data's suitability for factor analysis is indicated by the KMO value of .91 and the significant result of Barlett's Test of Sphericity ($\chi2$= 2350.43, df = 78). A one-factor structure was identified as a consequence of the principal-axis factor analysis (Figure 2). When determining the number of factors, ensuring that the eigenvalue associated with each factor is equal to or greater than 1.00 is recommended (Thompson, 2004). When determining the appropriate number of factors, it is recomended to consider several criteria. These include ensuring that the eigenvalue of each factor is equal to or

greater than 1.00 (Thompson, 2004), observing sharp declines in the scree plot, which is based on the eigenvalue, as well as high acceleration and relative flattening after a certain cut-off point (Fabrigar et al., 1999). Furthermore, it is important to consider factor loadings that are at least .32 (Kline, 2011; Tabachnick & Fidell, 2007). The explained variance of the single-factor structure was determined to be 38.14%. Since the factor loadings of the five items regarding the one-dimensional structure were not sufficient, they were excluded from the scale and the initial, common variance and factor loading values of the remaining 13 items are given in Table 2.
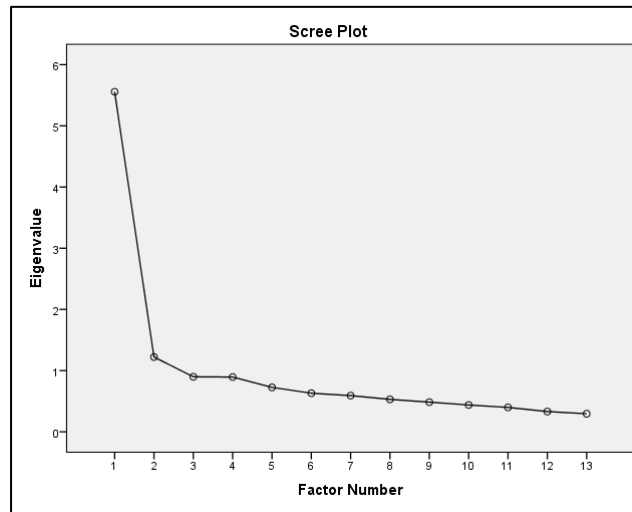
Figure 2. Scree plot for the Parental Competence Scale

Table 2

Factor structure of the Parental Competence Scale and factor loadings

Item no	Initial	Common variance	Factor loading
I1	.58	.53	.79
I2	.52	.44	.67
I3	.50	.49	.70
I4	.46	.46	.68
I5	.45	.45	.67
I6	.40	.41	.64
I7	.53	.41	.64
I8	.32	.33	.57
I9	.44	.35	.59
I10	.37	.33	.57
I11	.26	.25	.50
I12	.27	.26	.51
I13	.36	.26	.51

Explained variance: 38.14%

As shown in Table 2, the factor loadings ranged from .51 to .79, and the common variance value was .26, which is the smallest. CFA was used to test the 13-item, one-dimensional structure obtained from principal-axis factor analysis. Modifications were made to achieve better-fit indices. The modifications were the identification of error covariances among items I1-I2 and I7-I13. Table 3 provides the unstandardized factor loading, standard error (SE) and t-values demonstrating the relationship between the items and the model.

Table 3

Unstandardized factor loading, SE and t values obtained from CFA

Item No	Unstandardized factor loading	SE	t-value
I1	.29	.44	8.15
I2	.36	.41	10.39
I3	.45	.40	12.59
I4	.42	.28	14.35
I5	.43	.33	13.41
I6	.43	.29	14.24
I7	.37	.27	10.51
I8	.25	.17	10.95
I9	.35	.23	11.74
I10	.39	.42	11.03
I11	.29	.29	9.97
I12	.42	.40	11.75
I13	.41	.23	14.32

As shown in Table 3, t-values ranged from 8.15 to 14.35, and all values were significant and greater than 1.96. Therefore, all items on the one-dimensional scale were determined to be compatible with the model. Excellent and acceptable fit values for fit indices and fit index values determined by CFA can be found in Table 4.

Table 4

Perfect and acceptable fit values for fit indices and fit index values obtained from CFA

Reviewed Indices of Fit	Perfect Fit Criteria	Acceptable Fit Criteria	Achieved Fit Indexes	Conclusion
$\chi2/sd$	$0 \leq \chi2 / sd \leq 2$	$2 \leq \chi2 / sd \leq 5$	3.38	Acceptable
RMSEA	$.00 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$	.07	Acceptable
NFI	$.95 \leq NFI \leq 1.00$	$.90 \leq NFI \leq .95$	.90	Acceptable
NNFI	$.95 \leq NNFI \leq 1.00$	$.90 \leq NNFI \leq .95$	.90	Acceptable
PNFI	$.95 \leq PNFI \leq 1.00$	$.50 \leq PNFI \leq .95$	.72	Acceptable
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$	.92	Acceptable
IFI	$.95 \leq IFI \leq 1.00$	$.90 \leq IFI \leq .95$	.92	Acceptable
SRMR	$.00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$	.05	Acceptable
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI \leq 95$	.93	Acceptable
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI \leq .90$	.90	Acceptable
PGFI	$.95 \leq PGFI \leq 1.00$	$.50 \leq PGFI \leq .95$	.64	Acceptable

$\chi2= 213.36$, *df*= 63, 90% Probability Confidence Interval for RMSEA = (0.06 ; 0.08)

Reliability and Item Statistics

Both Cronbach Alpha coefficient and McDonald's omega were computed as .88. The statistical data about the items is shown in Table 5. As shown in Table 5, the corrected item-total correlations for the items on the scale ranged from .47 to .68. These values indicate that the items can distinguish individuals based on the measured structure. The t-values ranged from 12.95 to 20.93 and were statistically significant ($p < .01$). Using t-tests for independent samples, the differences between the item scores of the 27% lower and upper groups were examined. The obtained t-values proved that the items distinguish between individuals with and without the measured feature.

Table 5

Results of item analysis

Item no	Average	Standard deviation	Corrected item-total correlation	If item dropped (Cronbach's Alpha)	If item dropped (McDonald's Omega)	t
I1	3.98	.70	.68	.87	.87	19.18*
I2	3.95	.74	.62	.88	.88	17.09*
I3	4.07	.73	.66	.87	.87	20.93*
I4	4.06	.73	.64	.87	.88	19.00*
I5	4.12	.68	.63	.87	.88	16.61*
I6	4.23	.72	.60	.88	.88	15.71*
I7	4.29	.61	.60	.88	.88	19.04*
I8	4.59	.56	.54	.88	.88	15.27*
I9	4.43	.59	.55	.88	.88	16.81*
I10	3.94	.75	.54	.88	.88	13.93*
I11	4.43	.61	.47	.88	.88	13.36*
I12	4.29	.68	.48	.88	.88	13.97*
I13	4.33	.59	.47	.88	.88	12.95*

Study 2

Before performing the structural model, the measurement model was tested using the data collected from 261 mothers. Correlations between observed variables are shown in Table 6, while correlations between latent variables are shown in Table 7.

Table 6

Means, standart deviations and correlations among the observed variables

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 F1	4.01	.97	1	.73	.70	.60	.73	.38	.41	-.40	-.39	-.44	-.45	.22	.28	.26	.26
2 F2	3.88	.92		1	.80	.62	.77	.34	.38	-.41	-.38	-.40	-.43	.26	.26	.26	.26
3 F3	3.93	.89			1	.63	.71	.26	.31	-.34	-.26	-.32	-.38	.15	.20	.19	.15
4 F4	4.39	.82				1	.70	.32	.37	-.21	-.23	-.25	-.27	.12	.15	.13	.15
5 F5	3.94	.95					1	.40	.41	-.37	-.38	-.38	-.41	.24	.29	.25	.30
6 ES	10.99	2.60						1	.82	-.33	-.33	-.40	-.37	.31	.42	.39	.31
7 IS	10.82	2.95							1	-.31	-.32	-.41	-.37	.23	.31	.30	.21
8 PRCLS1	10.86	3.20								1	.72	.67	.73	-.41	-.42	-.43	-.47
9 PRCLS2	10.10	3.15									1	.71	.73	-.36	-.43	-.41	-.39
10 PRCLS3	11.49	3.42										1	.71	-.34	-.37	-.40	-.34
11 PRCLS4	9.07	3.14											1	-.46	-.51	-.50	-.47
12 PRCLC1	12.65	1.67												1	.64	.66	.75
13 PRCLC2	11.81	1.82													1	.83	.68
14 PRCLC3	11.60	2.01														1	.62
15 PRCLC4	16.35	2.28															1

Notes: *N*=261

F1-F5: Family Harmony, ES: Emotional Support IS: Instrumental Support

PRCLS1-PRCLS4: Four parcels of Parenting Stress, PRCLC1-PRCLC4: Four parcels of Parental Competence

The correlations between the latent variables, as seen in Table 7, showed a moderate level of correlation. More specifically, as shown in Table 7, parenting stress was negatively correlated with family harmony ($r = -.53, p < .05$), perceived available support ($r = -.47, p < .05$) and parental competence ($r = -.60, p < .05$). Perceived available support was positively associated with parental competence ($r = .44, p < .05$) and family harmony ($r = .50, p < .05$). Futhermore, there was a positive significant relationship between parental competence and family harmony ($r = .36, p < .05$). The unstandardized factor loadings, standard errors, and t-values for the measurement model are shown in Table 8, and the standardized parameter estimates for the measurement model are shown in Figure 3.

Table 7

Correlations among the latent variables

Latent variables	1	2	3	4
1 Family harmony	1.00	.50*	-.53*	.36*
2 Perceived available support		1.00	-.47*	.44*
3 Parenting stress			1.00	-.60*
4 Parental competence				1.00

Notes: *N*= 261, *p* < .05

Table 8

Unstandardized factor loadings, standard errors, and t-values for the measurement model.

	Unstandardized factor loading	*SE*	t
FH			
1 F1	.79	.05	15.52
2 F2	.83	.04	18.35
3 F3	.77	.04	17.09
4 F4	.59	.04	13.02
5 F5	.82	.05	16.99
PS			
6 ES	2.37	.14	16.42
7 IS	2.62	.17	15.83
PST			
8 PARCELS1	2.67	.17	16.09
9 PARCELS2	2.67	.16	16.46
10 PARCELS3	2.81	.18	15.75
11PARCELS3	2.73	.16	17.16
PC			
12 PARCELC1	1.26	.09	13.86
13 PARCELC2	1.65	.09	18.34
14 PARCELC3	1.78	.10	17.62
15 PARCELC4	1.70	.12	13.63

The test of the measurement model resulted in acceptable goodness-of-fit statistics: $\chi2/df$ = 2.56, RMSEA= .08 (90% confidence interval for RMSEA = .06; .09), NFI = .93, NNFI = .94, PNFI = .74, CFI = .95, IFI = .95, RFI = .91, RMR = .20, SRMR = .04, GFI = .90, AGFI = .86, PGFI = .63. Following the assessment of the measurement model, the structural model was tested. Figure 4 shows standardized parameter estimates for the structural model.
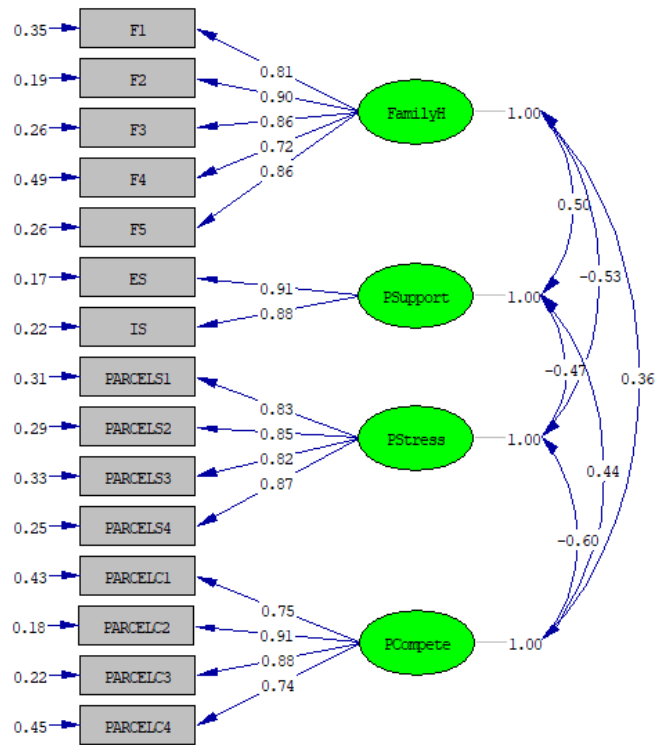
Figure 3. Standardized parameter estimates for measurement model

The test of the structural model resulted in acceptable goodness of fit statistics: $\chi^2/sd = 2.53$, RMSEA = .08, (90% confidence interval for RMSEA = .06; .09), NFI = .93, NNFI = .94, PNFI = .75, CFI = .95, IFI = .95, RFI= .91, RMR = .20, SRMR = .04, GFI = .90, AGFI = .86, PGFI = .64.
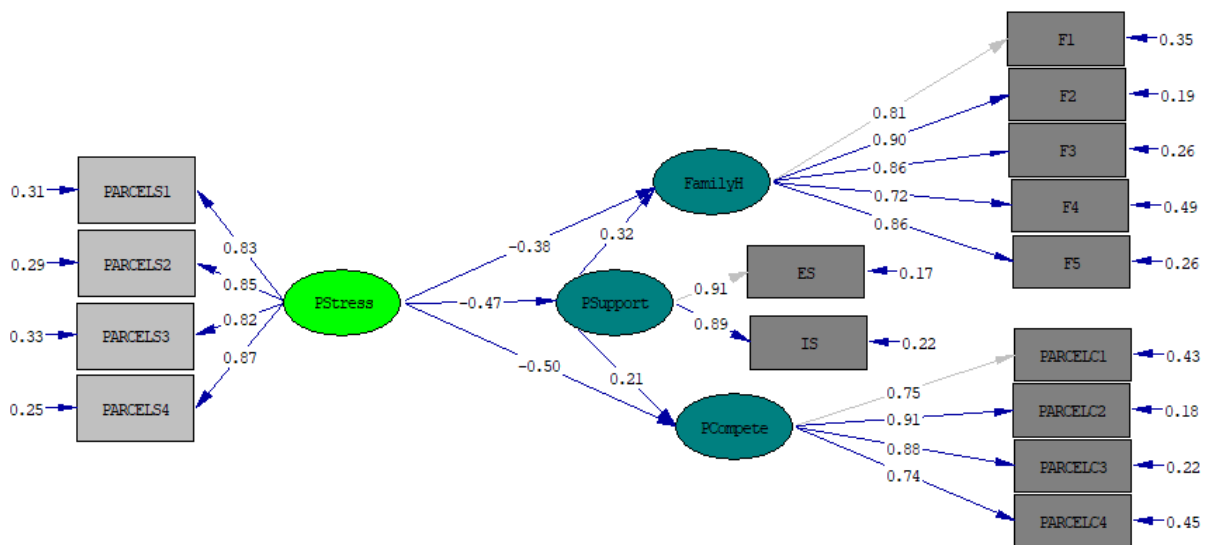
Figure 4. Standardized parameter estimates for the structural model

Standardized estimates for the paths in the model are shown in Figure 4. As seen in Figure 4, the estimated correlation between parenting stress and family harmony was -.53; however, when the mediator (perceived available support) was included in the model, the direct effect of parenting stress on family harmony was reduced to -.38. Clearly, the relationship between parental stress and family harmony was partially mediated by perceived available support, as evidenced by the findings. The estimated correlation between parenting stress and parental competence was -.60, and the direct effect of parenting stress on parental competence decreased to -.50 when the mediator (perceived available support) was added to the model. That is, the relationship between parenting stress and parental competence was partially mediated by perceived available support. Table 9 shows the bootstrap analysis results, which assessed the statistical significance of the mediation effect of perceived available support in the relationship between parenting stress and both family harmony and parental competence.

Table 9

Bootstrap analysis results

Model I: Perceived available support between parenting stress and family harmony			
Standardized indirect effect	Boot standard error	BootLLCI (Lower value)	BootULCI (Upper value)
-.34	.09	-.52	-.15
Model 2: Perceived available support between parenting stress and parental competence			
-.16	.04	-.25	-.08

In Model 1, the standardized value for the lower bound was -.52, while the standardized value for the upper bound was -.15. Significant mediation is inferred when the upper and the lower limits of the 95% CI do not include zero. Based on the absence of the value "0" within this range, so it can be said that the mediation role of perceived available support between parenting stress and family harmony is statistically significant.

In Model 2, the standardized value for the lower bound was -.25 and the standardized value for the upper bound was -.08. Because of the absence of the value "0" within this range, it can be inferred that the mediation role of perceived available support between parenting stress and parental competence is statistically significant.

Discussion, Conclusion & Suggestions

This study was carried out with two purposes. The objective of Study 1 was to develop and examine the psychometric properties of the Parental Competence Scale, an original instrument designed to assess the level of perceived parental competence among mothers with 3-6-year-old children in a large sample within the Turkish cultural context. For this purpose, first of all, the item pool of the scale was created. After this stage, necessary corrections were made to the items based on expert opinions, and the scale became ready for pre-application. The scale's validity (EFA and CFA), reliability (internal consistency), and item analyses were carried out. The objective of Study 2 was to examine the direct and indirect effects of parenting stress on parental competence and family harmony via perceived available support.

In Study 1, EFA results showed that the scale displayed a single-factor structure consisting of 13 items, with a high level of explained variance. The scale's 13-item format will make it a valuable tool for large-scale research and help to reduce participant and operational burdens. With a single-factor structure explaining 38.14% of the overall

variance, it's clear that the items on the scale are collected satisfactorily into a single component. As Çokluk et al. (2012) stated, a 30% or more variance explained in single-factor designs in social sciences may be considered sufficient. In addition, considering that the two-factor structure of the Parenting Sense of Competence (PSOC), developed by Gibaud-Wallston and Wandersman (1978) and one of the most frequently used scales in the literature explained 36% of the total variance (Gilmore & Cuskelly, 2008), it is a pretty good finding that the one-factor structure of the Turkish Parental Competence Scale explained 38.14% of the total variance. In this single-factor structure, the factor loading values of the items varied between .50 and .79. According to Büyüköztürk (2010), factor loading values should be .45 or higher. From this point of view, it can be said that the factor loading values of the items in the scale are well. Besides that, after identifying error covariances between Item 1 - Item 2 and Item 7 - Item 13, it was determined that CFA results showed that the scale fitted the data well, providing support for the single-factor structure and demonstrating an acceptable level of goodness of fit. Cronabch's alpha and McDonald's omerga values, which were calculated within the scope of reliability analysis, also revealed that the scale showed a high level of internal consistency. Although test-retest reliability and criterion-related validity studies were not performed in Study 1, EFA, DFA, item analysis and internal consistency analyses showed that the scale is a valid and reliable tool. In addition, the data collected in three distinct phases for the scale ensures that the data conform to the unidimensional structure, which is a study's strength.

In Study 2, analyses demonstrated that parenting stress was negatively associated with parental competence and after perceived available support was included in the model, direct effect of parenting stress on parental competence reduced. This finding indicates that perceived available support mediates the link between parenting stress and parental competence. More specifically, mothers who perceive more parenting stress would experience less parental competence, while mothers who receive more social support would experience less parenting stress and more parental competence. Consistent with these findings, previous research has supported that higher levels of parental stress are associated with lower levels of parental competence (Gondoli & Silverberg,1997; Jackson & Huang, 2000) and adequate social support can reduce the negative effects of increased parental stress (Perez & Rubio, 2023; Rodgers, 1993). According to Hoover-Dempsey et al. (2005), parents who experience less stress feel more competent in their parental role, demonstrating more confidence in their ability to nurture their children. Ecological and systemic standpoints have suggested that social support plays a crucial role in either strengthening or weakening parental competence (Belsky et al., 1984; Cochran & Brassard, 1979). The findings of the present study may also have a culture-specific aspect. Gülerce (1996) proposed, based on her research on family psychological patterns in Turkey, that mothers take greater ownership of the family system than other family members, commit a substantial amount of personal resources to the system, and are proud of the family's competence. On the basis of this argument, it can be assumed that mothers tend to consider parental competence as a crucial aspect of achieving family competence, and as a result, they are more likely to question their own competence levels and experience heightened parental stress.

Furthermore, Study 2 showed that parenting stress was negatively related to family harmony and after perceived available support was entered into the model, the direct effect of parenting stress on family harmony reduced. This finding points out that perceived available support mediates the link between parenting stress and family harmony.

That is, mothers who perceive more parenting stress would perceive less family harmony, while mothers who receive more social support would perceive less parenting stress and more family harmony. This finding indicates that mothers' beliefs in their competence as parents and their perceptions of family harmony increase as their subjective perceptions that friends, partners, family, and other people will assist them in times of need increase. Family harmony is interconnected with the concepts of "interconnectedness," "interdependent self," "interdependence with others," "sense of closeness," and "relatedness" in the interpersonal relationships literature (Kjell et al., 2016, p. 912) and a highly effective kind of interpersonal harmony (Demirci, 2022). This concept primarily reflects the perspective of collectivist cultures regarding family relationships (Oyserman et al., 2002) and is widely recognized as a fundamental component of effective family functioning in collectivist societies, such as China, Turkey, etc. In a qualitative study conducted by Lam et al. (2012) with Chinese individuals explored that harmonious families exhibit characteristics such as open communication, mutual respect, and dedicating quality time to one another, while experiencing little conflict. In another study conducted by Demirci (2022) in Turkey found that family harmony predicts flourishing indirectly via interdependent happiness and individual harmony in life. In addition, while some studies indicated that the presence of family harmony can function as a protective factor against the negative effects of stress (Keller & Honig, 2004), the current study demonstrated that parenting stress undermines family harmony but that available social support functions as a buffer, reducing the negative effect of parental stress on family harmony. Recent research indicated that in families that value family harmony, individuals use two approaches to improve it: "disintegration avoidance" and "harmony enhancement." Individuals make sacrifices to maintain harmonious relationships and avoid open conflicts in families that promote inner harmony through disintegration avoidance. In contrast, members of families that practice harmony enhancement to attain inner harmony engage in open communication and problem-solving while maintaining respect for one another (Cheung et al., 2020). In the present study, the negative relationship between parenting stress and family harmony could be linked to mothers' inability to discuss stressful parental circumstances in an open manner and with mutual respect as their negative emotions and perceptions about parenting increase. The availability of support resources may increase the likelihood that mothers will be able to resolve stressful parental issues through open communication and mutual respect, thereby contributing to family harmony.

This study confirmed the influence of parenting stress on parental competence and family harmony. It also provided an empirical foundation for empowering mothers with children between the ages of 3 and 6 regarding parental abilities. Utilizing the obtained findings in early childhood education programs can enhance the effectiveness of future research and practices. Given the significance of parental competence in fostering positive parenting outcomes (Martínez-González et al., 2016), developing an intervention program to proactively and preventatively enhance parenting competencies among families with children in the preschool age period would be beneficial for empowering family life. In addition, the implications of this study are also crucial to family counseling. When family counselors work with parents and encourage them to identify and utilize social support sources, this intervention may reduce family stress (Perez & Rubio, 2023) and improve family harmony.

Although this study contributes to the existing literature by explaining the relationships among parental competence, family harmony, parental stress, and perceived available support, it is important to note that it has some

limitations. First, the research design of this study was cross-sectional. Conducting experimental research to establish causality, and carrying out longitudinal studies to follow time-based variation in future research will aid in gaining a deeper understanding of research variables. Second, although the scale's validity and reliability assessments were conducted with mothers who had children aged 3-6, the scale can also be used to assess fathers' parental competence. Psychometric features of the scale for fathers with children aged 3-6 can be examined in future studies. Finally, although the role of social support as a mediator was examined in the study, the participants were not asked about their most significant sources of social support in family matters or whether they received support from these people regarding their parental roles and responsibilities. Collecting such data in future studies will contribute to understanding the dynamics of perceived available support regarding parental competence and family harmony.

Ethic

We declare that the research was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all participants included in the study.

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An Evaluation of Preschool Children's Books with Respect to the Principle of Appropriateness for Children

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Abstract

This study aims to determine the suitability of the books to the principle of appropriateness for children. The research database, modelled in the form of case study, one of the qualitative methods, consists of a selection of 60 books that were randomly selected among the most read preschool children's books, targeting an audience aged 0 to 6 years. The data, which were organized using descriptive analysis, underwent a thorough examination through content analysis. Educational messages in the books presented explicitly and implicitly were also identified using the document analysis method, analyzed through the descriptive analysis method, and evaluated in terms of children's education and development. The cases in which the texts of pre-school children's books can be characterized as conflicting with the principle of appropriateness for children can be categorized as follows: errors in language and expression (spelling and punctuation mistakes; non-adherence to textuality criteria; inadequate attention to consistency; selection of words unsuited to children's cognitive development; and translation errors), errors related to images (image-text mismatch, or inconsistency between images), and errors concerning children's universe of meaning (explicit and implicit messages that diverge from values-oriented education). The results of the study were discussed in detail, supported by the relevant literature. As a result, to mitigate the potential adverse effects arising from errors in children's books, it becomes essential to follow the basic principles of children's literature as to the communication of explicit and implicit messages, to review books in detail before they are presented to children, and to organize the content accordingly.

Key Words

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Concepts

The process of education begins within the familial context during the pre-school period, sustaining an uninterrupted trajectory throughout the entirety of an individual's lifespan. Among the foundational elements of family-based education in the pre-school period, parental engagement in reading books to their children stands out as a pivotal contributory factor. The input conveyed to children by means of books, serving as exemplars of children's literature, is recognized to wield a dual impact, contributing to children's cognitive, personal, and societal development, as well as to the cultivation of their language skills. Considering this rationale, it is anticipated that children's books should be composed with a profound sensitivity to their vantage point, in congruence with the authentic realm of children's experience. Children's books therefore diverge from the books intended for adult readers, necessitating the incorporation of distinct features and adherence to some essential principles (Sever, 2013b). The books directed at children must be tailored to align with the age range of the intended readership, while encompassing features capable of engaging the interest of young readers. The linguistic and expressive components embedded within children's books have the potential to enrich young readers' vocabulary and enhance their ability for eloquent self-expression. In this manner, the advancement of both receptive and productive language skills is facilitated. To this end, the content of a book should be interwoven with a logical structure, characterized by succinctness and comprehensibility, while also encompassing affirmative values (Hsiao & Chang, 2015). Ensuring logical and semantic integrity requires the meticulous selection of appropriate language and narrative elements for character and plot exposition, supplemented by visual components. Through the coherent incorporation of linguistic and visual elements in books, children can internalize words, lexical bundles, and set phrases that are commonly used. While selecting books, hence, it is important to consider language and expression aspects that cater to children's receptive language skills, ensuring that expressions, words, and images resonate with children's universe of meaning. Messages intended for children via books should resonate with their world of feelings and thoughts, ensuring a meaningful connection. Children's books characterized by these qualities hold the potential to nurture proficiency in language and communication skills.

Aside from their linguistic content, children's books stand as resources that demand careful attention with respect to their visual components. Particularly during the preschool phase, as children have yet to develop literacy skills. Therefore, their attention is predominantly directed towards visual messages rather than linguistic cues within books (Evans & Saint-Aubin, 2005). They derive semantic content by engaging with the visual depictions presented (Yaden et al., 1993), concretizing and assigning meaning to textual material through these images.

Rationale and Purpose of the Study

Children in the pre-school phase are initially acquainted with the act of reading through visual engagement with books. Prior to the initiation of primary literacy education, it therefore becomes essential to nurture children's visual literacy skills with an emphasis on the cultivation of conceptual maturation (Karatay, 2011; Sever, 2013a). Children's picture books are crucial in the development of visual literacy skills at an early age. Books featuring high-quality visuals additionally serve as a catalyst for fostering children's grasp of visual aesthetics. Therefore, in the

context of advancing receptive language skills, the alignment of content with visual components, the quality of images that derive meaning from content, and their associated implications all hold considerable significance.

The selection of visual and linguistic messages tailored for children, which should be guided by adherence to specific qualities, demands caution on the part of adults. Sever (2013b) asserts that the principal element in books intended for preschool children, in relation to both design and content, is the visual component, and this view is predicated on the fact that children mentally complete the narrative of the text through the visual depictions presented in the books. Nevertheless, it is evident that these attributes do not receive adequate consideration in the design of certain books. This research aims to analyze the educational messages conveyed through both visual and linguistic elements in these books, as well as to assess their alignment with the principle of appropriateness for children, fostering cognitive development, and enhancing language skills.

The scholarly literature contains various studies that explore preschool children's books from diverse perspectives, including matters of values (Alpay & Tuna, 2021; Cengiz & Duran, 2017; Körükçü et al, 2016), aspects of form and content (Bakırcı, 2022; Bekkaya & Güven, 2021; Çolaklar, 2019; Gönen & Aydos, 2013; Gönen et al., 2014; Gönen et al., 2016; Körükçü, 2012; Turan & Ulutaş, 2016; Yıldız, 2016), and the criteria used by teachers, parents, and preschool children while selecting books (Can et al., 2022; Külcü, 2019; Maniam, 2011; Pekdoğan, 2017; Saçkesen, 2008; Turan et al., 2017; Ulutaş, 2017; Uslu, 2020; Yükselen et al., 2016). While these studies often include images in the external structural features (form) of the books, the messages conveyed within the books are typically limited to linguistic means and are primarily evaluated within the internal structural aspects (content) of the books. Nonetheless, it should be posited that the messages examined within the internal structural aspects of books are not to be confined solely to linguistic structure, and the complementary nature of visual reading in enhancing linguistic content and meaning underscores the need for a holistic understanding of meaning. There are also studies in the literature that examine children's books according to the principle of suitability for children (Bilgin, 2011; Burç, 2013; Çakır, 2013; Karaca & Temizyürek, 2017; Özer, 2007; Yeniçeri & Kuşdemir, 2019).

This study endeavors to highlight the semantic implications, values, and educational elements embedded within the linguistic and visual content conveyed to children through the medium of books. Aligned with these objectives, it sought to address the following research questions:

i. How can the linguistic and visual messages in preschool children's books be evaluated in terms of the principle of appropriateness for children?

ii. What factors within the context of preschool children's books exert adverse effects on children's universe of meaning?

Method

Research Design

Adopting the qualitative approach, this study is designed using the case study model. This model, distinguished as a unique design for the qualitative approach (Creswell, 2020; Silverman, 2018; Stake, 1995), aims to achieve a close and profound comprehension and manifestation of an individual or a few select situations (Yin, 2017). The

case study facilitates the examination of a present-day phenomenon within its authentic contextual framework (Merriam, 2018). This design is well-suited for circumstances where the objective is twofold: to address descriptive/explanatory research questions and to facilitate the need for thorough evaluation (Silverman, 2018; Yin, 2017). The unit of analysis under examination in this study revolves around the visual and linguistic messages contained in picture books tailored for preschool children. In instances involving multiple units of analysis, emphasis is placed on the specific subunit or subunits within the given context. This scenario facilitates the exposition of intertwined situations (Yin, 2017). Consequently, this study is designed in the form of an interwoven single case study.

Research Instruments and Data Collection Processes

The data in this study were collected using the document analysis method. The research database comprises a total of 60 different books, randomly selected from a collection of widely read preschool children's books published by 10 different publishing houses, all of which are among the best-selling publishers targeting children aged 0-6 years.Table 1 shows the preschool children's books that constitute the database of the study. All textual and visual elements present in the books, which form the core review materials of this study, have been evaluated within the parameters of the study's limitations.

Table 1

The preschool children's books that constitute the database of the study

Publication	Book	Original/English Name of the Book	Writer	Illustrator	Code
İşbank	İyi Yürekli Dev	The Smartest Giant in Town	Julia Donaldson	Axel Scheffler	B1
	Büyüdüğüm Zaman	When I Grow Up	Melanie Joyce	Lizzie Walkley	B2
	Akıllı Tilkinin Masalı	No Matter What	Debi Gliori	Debi Gliori	B3
	Hayvanat Bahçesinde Diş Fırçalama Günü	Der Grosse Zahnputztag Im Zoo	Sophie Schoenwald	Günther Jakobs	B4
	İşte Ben!	Exactly Like Me	Stephanie Moss	Gail Yerrill	B5
	Sevginin Gücü	The Pover of Love	Caroline Richards	Louise Anglicas	B6
Yapı Kredi	İyi Geceler Ay	Goognight Moon	Margaret Wise Brown	Clement Hurd	B7
	Ay'ı Kim Çaldı?	Who Stole the Moon?	Helen Stratton Would	Vlad Gerasimov	B8
	Ejderhalar da Tuvalete Gider mi?	Plassen draken ook?	Stefan Boonen	Hiky Helmantel	B9
	Bir Karın Dolusu Sır	Een buik vol geheimen	Pimm Van Hest	Nynke Talsma	B10
	Kendini Çok Seven Kurt	Le loup quı s'aımaıt beaucoup trop	Orianne Lallemand	Êlêono Thuillier	B11

	Uzaylılarla Adım Adım	A spasso con gli alieni	Emanuele Cirani	Ilaria Guarducci	B12
Beyaz Balina	Şşşt! Sessiz Olun!	Shhh! Quiet!	Nicola Kinnear	Nicola Kinnear	B13
	Seni Çok Seviyorum Kokuşuk Surat	I Love You Stinky Face	Lisa McCourt	Cyd Moore	B14
	Ben Sandalye Değilim!	I Am Not a Chair	Ross Burach	Ross Burach	B15
	Yağmurlu Bir Gün	Quick, Barney, Run!	Pip Jones	Laura Hughes	B16
	Kütüphane Tavşanı	Bunny's Book Club	Annie Silvestro	Tatjana Mai-Wyss	B17
	Dev Civciv	Chicken Big	Keith Graves	Keith Graves	B18
Mikado	Doktor Çantam	Mein Doktorkoffer	Luise Holthausen	Marlit Peikert	B19
	Dalgıç Köpek	Scuba Dog	Ann Marie Stephens	Jess Golden	B20
	Yemek Yiyorum	Eat Up, Maxie and Millie	Felicity Brooks	Desideria Guicciardini	B21
	Ben Küçük Değilim!	I'm Not Little	Alison Inches	Gleen Thomas	B22
	Louis'in Yendiği Gün	The Day Louis Got Eaten	John Fardell	John Fardell	B23
	Lorenzo Pizza Seven Istakoz	Lorenzo, The Pizza Loving Lobster	Claire Lordon	Claire Lordon	B24
Sincap	Ormana Dokun	Touch the Forest	Melek Dinçer	Damla Tutan	B25
	Çiftliğe Dokun	Touch the Farm	Melek Dinçer	Damla Tutan	B26
	Merhaba Duygularım	Hello My Feelings	Asiye Aslı Aslaner	Dilek Altıntaş Birben	B27
	Ormanda Saklambaç	Hide and Seek in the Forest	Serap Armutlu Acar	Dilek Altıntaş Birben	B28
	Çiftlikte Saklambaç	Hide and Seek on the Farm	Serap Armutlu Acar	Dilek Altıntaş Birben	B29
	Dolu Botlar	Plein Les Bottes	Leila Brient	Leila Brient	B30
Doğan Egmont	Bugün Ne Olalım? Harika Hayvan	I Want to Be-Amazing Animal	Ian Cunliffe	Ian Cunliffe	B31
	Bugün Ne Olalım? Mutlu Yardımcı	I Want to Be-A Happy Helper	Ian Cunliffe	Ian Cunliffe	B32
	Bugün Ne Olalım? Muhteşem Maceracı	I Want to Be-An Awesome Adventurer	Ian Cunliffe	Ian Cunliffe	B33
	Bugün Ne Olalım? Çılgın Yaratık	I Want to Be-A Crazy Creature	Ian Cunliffe	Ian Cunliffe	B34
	Burundaki Parmak	El Dedo En La Nariz	Paula Merlan	Ana Gomez	B35

	Dünyanın En Büyük Pırtı	El pedo mas grande del mundo / The World's Biggest Fart	Rafael Ordóñez	Laure du Fäy	B36
Marsık	Kaplanı Sakın Gıdıklama	Never Tickle a Tiger	Pamela Butchart	Marc Boutavant	B37
	Kral Leo'nun Oyuncak Ayusu	King Leonard's Teddy	Phoebe Swan	Phoebe Swan	B38
	Göl Kıyısında Bir Tatil	Een vacantie aan het meer	Florence Ducatteau	Chantal Peten	B39
	Büyüyorum ve Değişiyorum	Mariposa. Crezco y me transformo /I grow and transform	Pierre-Marie Valat	Pierre-Marie Valat	B40
	Bak Sen Şu Kedilere	All About Cats	Monika Filipina	Monika Filipina	B41
	Sesini Arayan Papağan Oskar	Harold finds a voice	Courtney Dicmas	Courtney Dicmas	B42
Butik	Cesur Minik Rakun	Chester The Brave	Audrey Penn	Barbara L. Gibson	B43
	Minik Rakun Arkadaşında Yatıya Kalıyor	Chester Raccoon and the Almost Oerfect Sleepover	Audrey Penn	Barbara L. Gibson	B44
	Minik Rakun Renk Oyunu	A Color Game for Chester Raccoon	Audrey Penn	Barbara L. Gibson	B45
	Minik Rakun ve İri, Kötü, Zorba	Chester Raccoon and the Big Bad Bully	Audrey Penn	Barbara L. Gibson	B46
	Bir Cep Dolusu Öpücük	A Pocket Full of Kisses	Audrey Penn	Ruth E. Harper & Nancy M. Leak	B47
	Minik Rakun İçin Öpülecek Bir El	A Kissing Hand for Chester Raccoon	Audrey Penn	Barbara L. Gibson	B48
Net	Sınırlarım ve Sırlarım	My Limits and Secrets	Yaşam Yanardağ Çelik	Berk Öztürk	B49
	Çocuklar için Cinsel Eğitim Öyküleri	Sex Education Stories for Children	Yaşam Yanardağ Çelik	Hülya Günal	B50
	Ding Dong! Kim Gelmiş?	Ding Dong! Who Arrived?	Cemre Arslan	Cemre Arslan	B51
	Yararlı Dostlar: Cincin Yarasa	Helpful Friends: Cincin Bat	Veronica Podesta	Monica Pierazzimitri	B52
	Nasıl Sünnet Oldum?	How Did I Get Circumcised?	Yaşam Yanardağ Çelik	Hülya Günal	B53
	Meritta Kirli Deniz	Meritta Dirty Sea	Ömer Canbir	Bahar Düzen Mete	B54
Can	Sihirli Tüy	Magic Feather	Claude Leon	Claude Leon	B55
	Sıradan Bir Gün	Niets Gebeurd	Mark Janssen	Mark Janssen	B56
	Renkli Öcüler	Colorful Monsters	Can Göknil	Can Göknil	B57

Gökte Bir Tekne	Un Batteau dans le Ciel	Quentin Blake	Quentin Blake	B58
Beni Annem Yavruladı	My Mother Breeded Me	Can Göknil	Can Göknil	B59
Uzun Yeleli Kediçocuk	Long-Haired Cat-Boy Cub	Etgar Keret	Aviel Basil	B60

Data Analysis

In the scope of this study, the data collected from the picture books designed for preschool children has been analyzed utilizing descriptive analysis and content analysis methods, which are among the qualitative data analysis approaches. The unfolding of the potential and content contained in qualitative data depends on its accurate analysis (Miles & Huberman, 2016). In the data analysis process of the research, a combined application of descriptive (deductive) analysis and content (inductive) analysis methods, recognized as types of qualitative data analysis, has been undertaken. Descriptive analysis involves the summarization and interpretation of data within the framework of designated themes (Patton, 2018; Yıldırım & Şimşek, 2021). Accordingly, the verbal and linguistic messages present in the books under examination have been coded, facilitating the establishment of preliminary categories through the systematic arrangement of the coded data. Following the completion of the descriptive data analysis, a subsequent stage involving thematic content analysis has been carried out. Content analysis serves as a technique for collecting and analyzing textual content (Neuman, 2014), and is employed in various fields for document analysis (Merriam, 2018; Neuendorf, 2017). Through this form of analysis, the latent facts embedded within the data (Yıldırım & Şimşek, 2021) are brought to light in a consistent and meaningful way (Patton, 2018). The procedure of content analysis involves a sequence of stages, including the examination of research data, the formulation of codes derived from the data, the recognition of themes, the construction of thematic networks, the preservation of thematic integrity, and ultimately the process of interpretation (Miles & Huberman, 2016; Robson, 2017). Within the framework of this research, the data organized through descriptive analysis have been subjected to a comprehensive and comparative examination through content analysis, resulting in the derivation of context-based concepts and conceptual themes.

At this stage, the study's validity and reliability were verified through expert opinions obtained from four academics : two specialists in English Language Education and two in Turkish Language Education, in addition to contributions from three preschool teachers.Through the application of the content analysis method, the following procedure was followed: Informed by the expert opinions of academics specializing in Turkish Language Education, the content analysis of the books in terms of visual content, language and expression, word choice, and meaning was undertaken. Drawing on the guidance of foreign language experts, a comprehensive content analysis targeting translation errors was carried out. Ultimately, relying on preschool teachers' insights, the alignment of books with the principle of appropriateness for children, particularly concerning their cognitive development, was investigated. The educational messages, explicitly or implicitly conveyed through the books, were also organized following expert insights, and identified and interpreted using the document analysis method. The identified educational messages

were analyzed through the descriptive analysis method and subsequently evaluated, taking into consideration their implications for children's education and development.

Findings

This study assesses preschool children's books in terms of their compatibility with the principle of appropriateness for children. In this regard , a comprehensive analysis has been undertaken on 60 different children's books designed for the preschool period, each from different publishing houses, and the findings derived from the examination of these books are presented through visual aids such as graphs, tables, diagrams, or images.

Certain findings obtained from the reviewed books could be characterized as deviating from the principle of appropriateness for children. The most noticeable shortcomings in the books can be categorized as errors related to language and expression, as well as errors associated with images. Given that these two categories collectively constitute the entire universe of meaning in the books, these shortcomings directly impact the intended meaning and educational content to be conveyed through the books. In Diagram 1, these shortcomings are visually presented. The diagram illustrates that linguistic and visual messages together comprise the universe of meaning in the books. At the point where linguistically and visually presented messages intersect, values are conveyed through these messages. This is because the values within the books intended for children are communicated not only through verbal but also through visual messages.

Diagram 1

Elements that negatively affect in preschool children's books
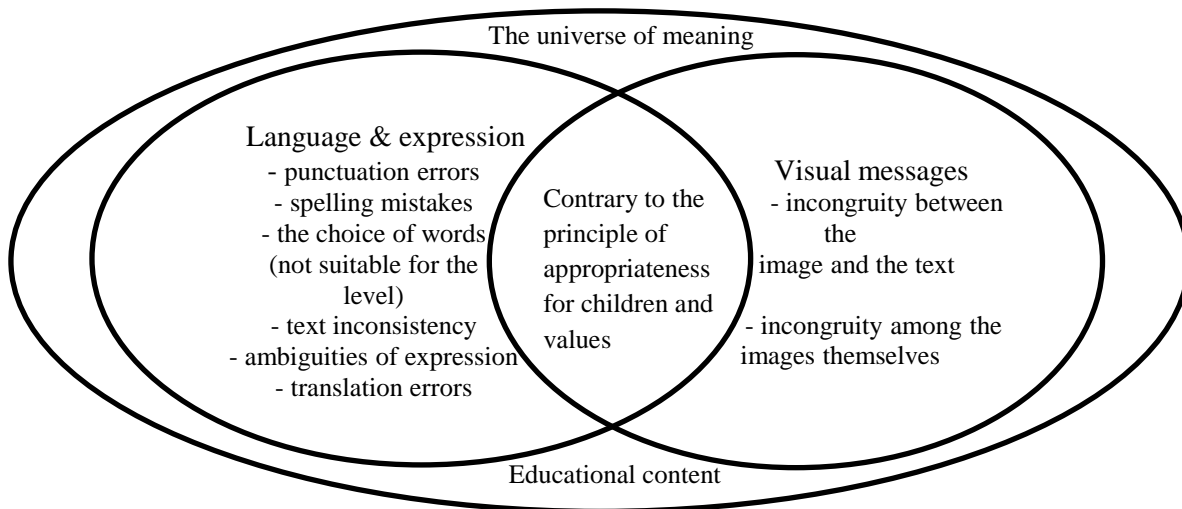
Table 2 displays the shortcomings identified in relation to the linguistic and visual content of the books, accompanied by their respective frequencies.

Table 2

The shortcomings identified in relation to the linguistic and visual content of the books

Categories	Codes	Book	n	%
Language and expression	Punctuation errors	B1, B2, B3, B5, B6, B7, B8, B9, B10, B11, B12, B14, B17, B19, B20, B21, B24, B28, B29, B30, B32, B35, B36, B37, B38, B39, B43, B44, B45, B46, B47, B49, B51, B52, B55, B56, B57, B58	38	63,33%
	Spelling mistakes	B5, B10, B12, B17, B19, B20, B21, B22, B23, B24, B27, B31, B33, B35, B36, B38, B41, B43, B44, B46, B49, B50, B51, B52, B53, B57, B58	27	45,00%
	The choice of words that are not suitable for the level	B1, B2, B8, B9, B11, B13, B14, B15, B17, B18, B22, B30, B31, B32, B33, B34, B36, B37, B38, B41, B50, B54, B55, B57, B60	25	41,67%
	The use of expressions contrary to the principle of appropriateness for children and values	B1, B2, B4, B8, B9, B10, B14, B15, B17, B18, B22, B33, B34, B35, B36, B37, B38, B39, B41, B54, B55	21	35,00%
	Translation errors	B40, B41, B42, B44, B45, B46, B47, B48	8	13,33%
	Text inconsistency	B7, B19, B20, B21, B23, B40, B49, B51	8	13,33%
	Ambiguities of expression	B3, B6, B32, B33, B52, B53	6	10,00%
Visual messages	The use of images contrary to the principle of appropriateness for children and values	B1, B2, B9, B10, B17, B23, B31, B33, B34, B35, B37, B39, B50, B59	14	23,33%
	Incongruity between the image and the text	B7, B25, B26, B45, B46	5	8,33%
	Incongruity among the images themselves	B7, B16, B32, B57	4	6,67%

In the table, errors linked to language and expression are divided into the following subcategories: Punctuation errors (n=38), spelling mistakes (n=27), the choice of words that are not suitable for the level (n=25), the use of expressions contrary to the principle of appropriateness for children and values (n=21), translation errors (n=8), text inconsistency (n=8) and ambiguities of expression (n=6). The subcategories encapsulating the shortcomings conveyed through visual messages consist of the use of images contrary to the principle of appropriateness for children and values (n=14), incongruity between the image and the text (n=5), and incongruity among the images themselves (n=4). The cases in which the texts of pre-school children's books can be characterized as conflicting with the principle of appropriateness for children concerning language include instances of spelling and punctuation mistakes, non-adherence to textuality criteria, inadequate attention to consistency, selection of words unsuited to children's cognitive development, and translation errors.

The frequencies presented in Table 2 indicate the types of shortcomings identified in the books. The frequency of these shortcomings can vary across different books. For instance, a book might contain multiple punctuation errors or spelling mistakes on each page, or it could have only one instance of such an error throughout the entire book. Moreover, the examined books might feature a single type of error, or they could encompass multiple distinct errors. This could mean that a book contains solely a spelling mistake or, alternatively, a combination of a spelling mistake, a translation error, and an inconsistency. As a result, it's important to note that the percentile values in the table do not provide a complete representation of the overall percentile distribution. Graph 1 illustrates the distribution of cases that do not align with the principle of appropriateness for children in the examined books.

Graph 1

The distribution of cases that do not align with the principle of appropriateness for children in the books
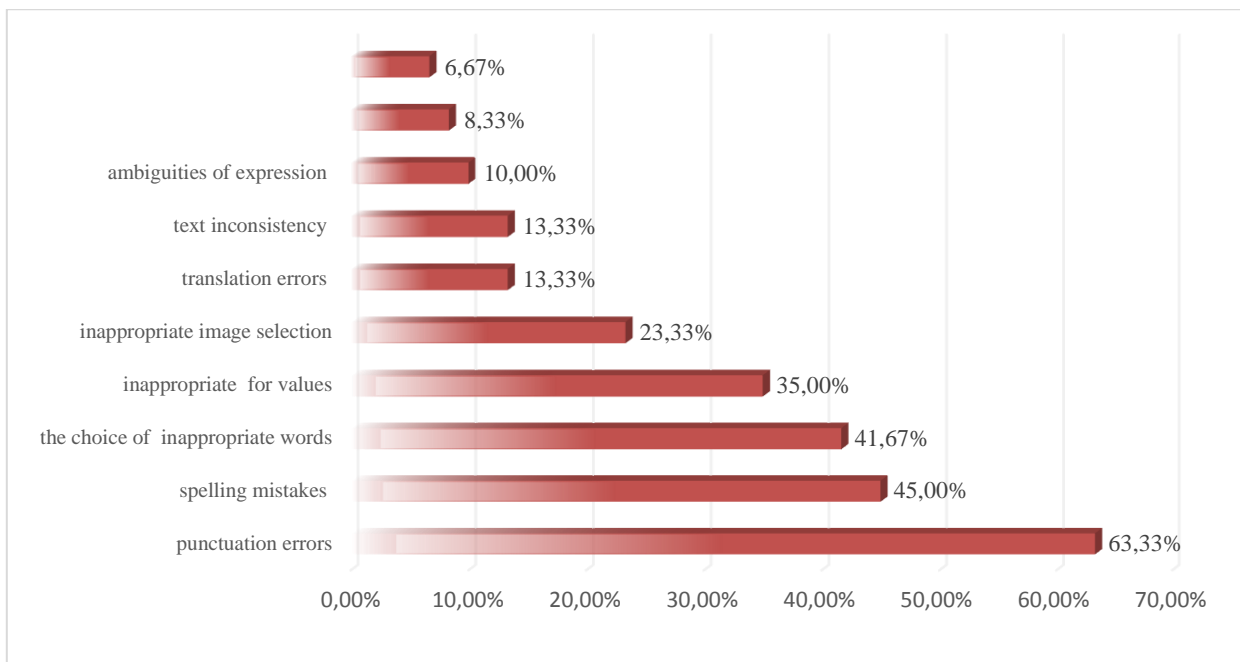
As can be seen from the graph, punctuation errors were found in 63.33% of the books. Punctuation errors include mistakes such as the unnecessary use of some punctuation marks (especially commas and semicolons), the omission of some punctuation marks (for example, opening but not closing quotation marks), the incorrect use of capital letters, etc. Apart from punctuation errors, the most common oversights are related to spelling mistakes (45,00%) and the choice of words inappropriate for children's developmental stages (41,67%). The use of expressions contrary to the principle of appropriateness for children and values was found in 35,00% of the books. The use of images contrary to the principle of appropriateness for children and values was found in 23,33%. The least identified shortcomings are translation errors (13,33%), text inconsistency (13,33%), ambiguities of expression (10,00%), incongruity between the image and the text (8,33%), and incongruity among the images themselves (6,67%).

Among the spelling mistakes, the most common are the misspellings of the Turkish circumflex accent (eg., hal-hâl) or confusing the spelling of the function words such as "de" [also] and "ki" as well as the affixes. Certain

spelling mistakes manifest as typographical errors, whereas others arise due to an insufficient understanding of Turkish grammar rules. Image 1 is presented to illustrate this situation. Spelling mistakes in the image are seen as a type of error that can cause ambiguity of expression while reading the text.

Image 1

An illustration depicting the spelling mistakes (B19)

Regarding word choice, the identified issues that deviate from the principle of appropriateness for children involve the use of words unsuitable for their cognitive development level or the selection of words that could potentially set unfavorable examples for children. There are also instances where the conceptual equivalents of words are supported by visuals (see Image 2). Among the words and expressions that are not suitable for children's level of understanding are terms that may be difficult for children to grasp at this stage (such as 'moon probe,' 'avast,' 'billage,' 'vulva,' 'ovule,' 'placenta'), as well as words that are not recommended for use due to their negative semantic-conceptual content (for example, 'pistol,' 'machete,' 'accursed castle,' 'delicious eye soup,' 'skull,' 'jar full of eyes,' 'wicked witch,' 'killer whale') found in both texts and images.

Image 2

An illustration depicting the inappropriate use of words and images (B34)

Textuality criteria hold significance for messages communicated verbally. An illustrative case of verbal errors that undermine text coherence involves the discontinuity of characters or images. In one of the examined books, as shown in Image 3, a main character is introduced as "Efe" in the first sentence and later as "Ege" in the third sentence on the same page. This inconsistency disrupts the continuity of the subject and character in the book. When it comes to the educational messages conveyed by the book, on the other hand, it has been identified that the book places emphasis on privacy education through clear descriptions and analogies catered to the understanding of children.

Image 3

A typo negatively affecting subject-character continuity and text consistency (B49)

An example of how coherence, as one of the textuality criteria, is negatively affected is evident in cases where consistency in verb tenses is overlooked. Image 4 illustrates an instance of verb tenses' inconsistency. The first sentence is in the simple present tense, while the second uses the simple past tense. In the subsequent sentence, the past continuous tense is utilized, followed using the future-in-the-past tense in the succeeding sentence. The final sentence reverts to the simple past tense. Additionally, a misspelling (direk) – which, in Turkish, means "column", but the intended meaning here is "directly" – is evident in the textual content of the same image. However, the image content clearly disregards the principle of appropriateness for children by including elements of fear.

Image 4

An example showcasing tense inconsistency, misspellings, and inappropriate visual content (B23)

Certain books contain negative messages and words carrying unfavorable semantic content, potentially conflicting with the principles of value-oriented education. To illustrate this, several examples from the examined books could be provided: Words with negative connotations such as "fool", "harpoon", "trickster", "smug" (from B11), "filthy thief" (from B18), "bandit", "outlaw" (from B17); expressions with messages diverging from values, such as "card game" (from B60), "drinking delicious eye soup" (from B34), "stealing" (from B8); and sentences that may cause conceptual confusion for children, such as "one day I will get married too, I'll find a woman with a swollen belly for myself, so I can have my own offspring" (from B59). This situation varies among books from different publishers and authors. To exemplify, in another book, the word "stealing" is substituted with the verb "disappear". Certain explicit and implicit messages that run counter to social and ethical values can be identified as part of the verbal and visual errors related to the universe of meaning. With respect to value-oriented education, it has been found that certain books contain unfavorable components for children. Moreover, these books incorporate semantic and conceptual information that exceeds children's cognitive capabilities and could set negative examples for them. Additionally, the books include both explicit and implicit messages that may lead to conceptual confusion on the part of children.

Image 5 and Image 6 stand as examples of situations where negative semantic-conceptual content is evident, not only in the choice of words but also in the selection of concepts depicted through images. The semantic content presented in these images, sourced from different books, stands in direct opposition to the ethos of privacy education for children. More specifically, Image 5 depicts a situation in which an adult serves as a role model for a child and meets his personal needs (i.e., toilet needs) in a public space, subsequently encouraging the child to follow suit. Similarly, Image 6 presents the act of a child openly urinating in a crowded public space as an ordinary occurrence. It is crucial to note that such images, both in terms of adults serving as role models for children and the importance attributed to societal norms, ethical values, and privacy education, epitomize messages that convey negative semantic content.

Image 5

An illustration of negative visual content portraying adults as role models (B9)
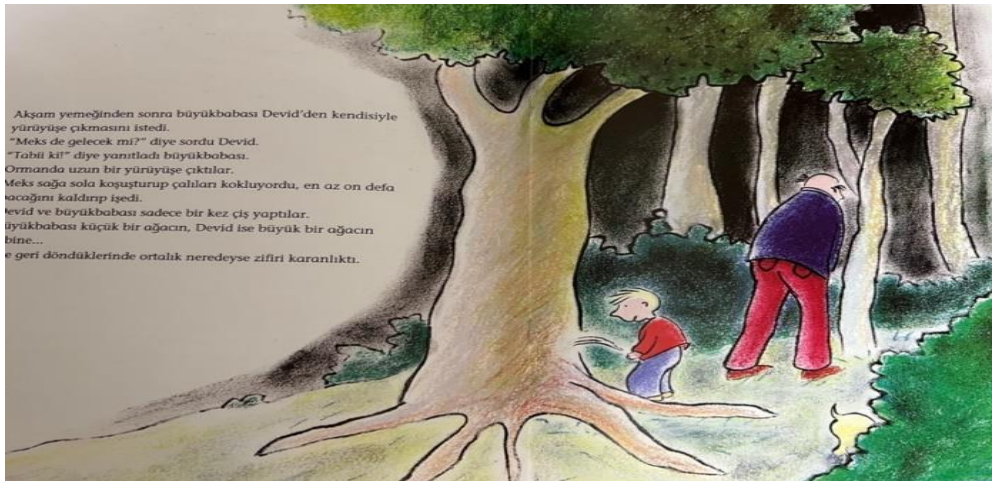
Image 6

An illustrative case of visual content odds with social rules and privacy education (B39)

Another illustrative example of visual messages deviating from accepted societal values and potentially leading to ambiguity in the context of sexual identity development is showcased in Image 7. It is striking that a male character in the book who is dressed in women's clothes is described as "scruffy" and depicted as poorly groomed and sloppy. Although the importance of cooperation as an educational message is emphasized to a great extent in the book, the verbal and visual presentation of the character's sloppiness, the depiction of the character in a woman's dress, and the fact that at the end of the book he undresses and stays on the street with his underwear are negative situations that can be seen as objectionable in terms of both gender identity education and privacy education.

Image 7

An example of visual content conflicting with social and ethical values (B1)

The most striking examples of the universe of meaning emerge in books for children's sexual education . However, certain books contain excessively detailed terms as well as visual and linguistic content that exceeds the comprehension level of children to a considerable extent. These materials reach a level of complexity similar to

topics covered in secondary school biology curricula, which children typically encounter at a later stage in their education.

Another objectionable element conveyed through both linguistic and visual content concerns expressions of violence. The prevalence of elements containing violence has been identified in certain books, occurring in some cases exclusively within visual depictions while in others spanning both visual and linguistic levels. Image 8 illustrates elements of violence that may be viewed as contradictory to the principle of appropriateness for children. While the textual content of this specific book does not explicitly contain violent language, it is worth noting that there is a recurrent display of inappropriate behaviors and elements of violence conveyed through images.

Image 8

The use of elements depicting violence, inappropriate for children, in visual content (B39)

The shortcomings of visual messages are not limited to the presentation of inappropriate content. At the core level, the issues associated with the images in books can be characterized by instances where visual elements do not overlap with one another or where discrepancies arise between the textual and visual contents. Image 9 serves as an illustration of the disparity between text and image. While the text specifies a "blue-colored tractor" (mavi renkli traktör), the image depicts a red tractor.

Image 9

An illustration of text-image mismatch (B26)
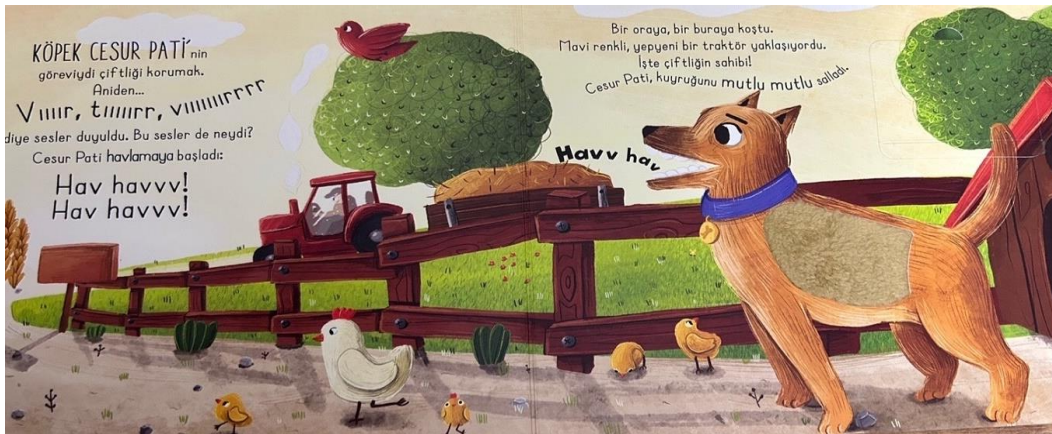
On the other hand, it is evident that some of the inconsistencies between images and content result from translation errors. An illustration of such an instance can be found in a paragraph from the book Chester Raccoon and The Big Bad Bully. In the book's original language, it reads, "When the racoons reached the school tree, Chester tugged on his mother's arm. 'That's him! That's the bully.' He pointed a trembling finger at a badger standing by the pond. 'Isn't he awful? Isn't he the most scary-looking bully you've ever seen?' ". However, a discrepancy arises as the English version explicitly uses the word "badger" and presents a badger in the image, but the Turkish translation renders the word "badger" as "rakun". This image-text inconsistency caused by the translation error is clearly seen in Image 10.

Image 10

An illustration of image-text mismatch due to translation error (B46)
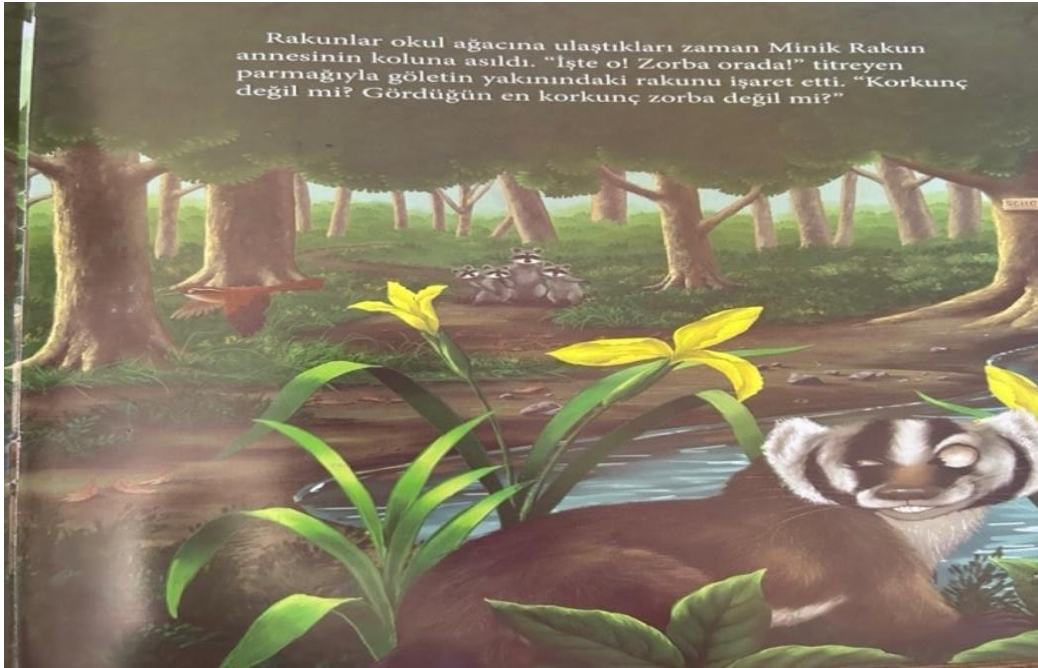
Similarly, Image 11 demonstrates a discrepancy between the image and content information, attributable to a comparable translation error found in another book by the same author and the same publishing house. The translation of the word "chester" in the sentence "Chester's black mask was brushed to a shine." into Turkish as "badger" (porsuk) disrupts the congruity between the image and content, resulting in non-overlapping elements. A close examination of the textual context shows that the expression "But his brother's was stuck full of cones from a pine" in the subsequent part of the sentence refers to the racoon, not the badger. This issue not only undermines the text's coherence but also introduces a semantic contradiction.

Image 11

Another illustration of image-text mismatch due to translation error (B45)
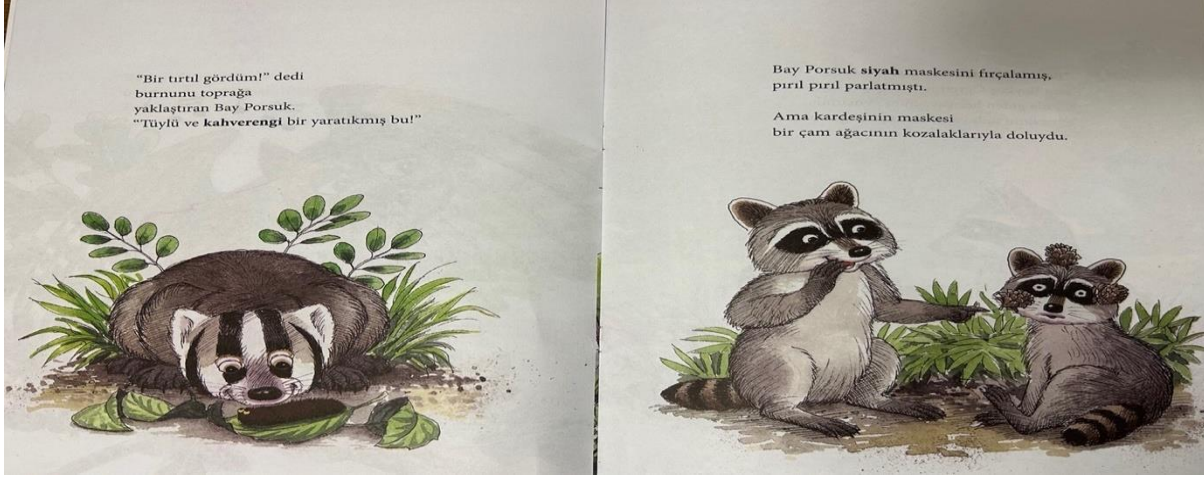
It should be acknowledged that all the books examined thus far hold considerable significance in terms of the positive educational messages they convey. However, some of those books demonstrate a tendency to overlook the principle of appropriateness for children, regarding the universe of meaning established by both linguistic and visual content.

Discussion, Conclusion & Suggestions

In this study, the universe of meaning conveyed through visual and linguistic messages in picture books intended for preschool children is evaluated with respect to the principle of appropriateness for children. A prevalent pattern identified in most of the examined books is related to linguistic messages, characterized by recurrent spelling and punctuation errors. This finding is completely different from the results of previous studies (Darga et al., 2021; Gönen et al., 2012; Gönen & Aydos, 2013; Gönen et al., 2014; Gönen et al., 2016), which found that in children's books, spelling rules are followed, and punctuation marks are used appropriately and correctly. However, this circumstance can be elucidated by the differences among the books under analysis. While certain instances of spelling and punctuation errors might be seen as minor typographical errors, others manifest as considerably more serious grammatical errors. Certainly, the presence of errors leading to the introduction of ambiguity within text can exert deleterious impacts on the process of language development in children. These errors, frequently construed as matters pertaining to stylistic nuances, exert a substantial influence on the facets of language and expression.

Whereas combining words that should be written separately (e.g., "hoşça kal" [goodbye]) might not alter the meaning, confusing the use of affixes or conjunctions potentially leads to ambiguity of expression and disrupts textual coherence. As also highlighted by Deniz and Gönen (2020), it is recommended that picture story books use language that is both clear and easily comprehensible, while also ensuring adherence to spelling and punctuation rules. However, it is seen that the necessary care was not taken during the writing process of the books. Yıldız (2016) affirms that children's books should maintain a level of error-free quality and should rigorously follow the rules of

grammar, spelling, and punctuation. Therefore, it is essential that books undergo a thorough editing process prior to being published.

Findings that do not comply with the principle of appropriateness for children in word selection are the choice of words inappropriate for children's cognitive development level, or the choice of words that may set a bad example for children (such as words used in offensive and insulting language or slang). In this context, it is imperative to consider vocabulary and expressions that surpass the cognitive capabilities of individuals at the developmental stage characteristic of children. This includes not only scientific or technical terminology but also vocabulary laden with negative semantic and conceptual connotations, which may be deemed unsuitable in the context of fostering optimal language development in children. As emphasized in several studies (Barnes et al., 2016; Tüfekçi-Can, 2014), children's books should feature texts that contain diverse and refined vocabulary to foster language development.

Books that address matters related to sexual education stand out as notable examples of using language that surpasses the cognitive capacity of children, making it challenging for them to grasp the concepts. These books evidently feature not only terms (such as vulva, ovule, placenta) that are notably beyond the comprehension level of children, but also complex and exclusively detailed visual and linguistic expressions. For example, one of the books suggests using the term penis instead of "pipi" (weenie). However, the word pipi is primarily defined as "the phallus in the language of children" in the up-to-date dictionary of the Turkish Linguistic Society (TLS, 2023), According to Öztürk and Feyman Gök (2021), children's picture books tend to emphasize male-female bodies the most among all elements of sexual education, while the concept of body value receives the least attention. Hence, they suggest placing a heightened focus on the concept of body value and endorse the adoption of anatomical terms to refer to genitalia. Nevertheless, in accordance with the viewpoints advanced by experts, notably those within the domain of early childhood education, there appears to be a prevailing tendency within children's literature to incorporate lexicon that aligns with the commonplace linguistic repertoire of children, rather than resorting to the inclusion of anatomical terminology. This opinion holds even more significance considering research indicating that complex sentences beyond children's level of comprehension and overly simple and basic sentences falling below their cognitive capacity can both adversely affect children's engagement with books (Karatay, 2011).

Another illustrative case, with potential negative influence on children in terms of word choice, involves the recurring use of pirate characters in most of the books. The word "pirate" (korsan) is defined as "a sea bandit, sea thief attacking ships" in the up-to-date dictionary of the TLS (2023). Concepts such as theft and banditry in this definition may be subject to criticism, as they inherently carry negative semantic associations for children. Similarly, it is striking that in some of the books, behaviors that can be considered negative according to value-oriented education are expressed with words reflecting negative content. For instance, the book titled Who Stole the Moon? (Ay'ı Kim Çaldı?) frequently features the verb "stealing" ("çalmak") within the text, where the unauthorized act of taking items belonging to others is presented in a manner that might inadvertently normalize this behavior.

Nonetheless, it should be noted that this case varies across other books centered on the same topic but published by different publishing houses and written by different authors. More specifically, another book narrates an identical case by using the expression "disappearing" instead of the word "stealing". Presenting scientific and accurate

information as part of books' educational content makes them valuable and particularly favored. However, it is crucial to bear in mind that the author's choice of words plays a pivotal role in the development of children's knowledge pertaining to language. While the way different authors express the same subject is a reflection of their individual styles, this divergence particularly concerns children's education and development, and influences the quality of books and the universe of meaning conveyed within them. It is necessary to avoid a form of expression that is not suitable for children and the use of words that are difficult for them to understand (Oğuzkan, 2013). A thorough consideration of children's universe of meaning is the prerequisite for selecting words that align with the principle of appropriateness for children. Deniz and Gönen (2020) emphasize the paramount importance of employing an extensive lexicon within the realm of children's literature, with a particular emphasis on the incorporation of lexemes that facilitate the cultivation of intricate semantic nuances and the evocation of vivid imagery. Additionally, their recommendations encompass the introduction of novel vocabulary replete with unfamiliar meanings, as well as the utilization of familiar words in divergent semantic contexts.

In the book The Smartest Giant in Town ("İyi Yürekli Dev Memo"), the messages conveyed through word choices stand out as contentious, revealing certain shortcomings. While the book indeed underscores the significance of collaboration within its educational messages, it simultaneously harbors objectionable components pertaining to principles such as self-care, self-discipline, and privacy. These contentious elements involve describing the main character as "scruffy" ("pasaklı"), attiring him in women's garments although he is a man, and depicting negative content such as walking on the street in underwear at the end. Başaran et al. (2021) also find this book unsuitable for children due to its form and content features, largely owing to the presence of words with inappropriate content. The research findings of Başaran et al. (2021) align with the outcomes highlighted in this study, particularly concerning the identification of negative language expressions, words, and idioms that are not suitable for the intended age group yet are present in the analyzed books. While not entirely aligned with the database of the present study, the occurrence of similar findings, particularly with respect to the books examined, across different studies is noteworthy. Concerning the semantic messages conveyed through both images and texts, instances that potentially contradict gender roles, moral and societal values have been identified. Although this outcome diverges from the findings reported in studies by Gündüz Şentürk (2015), Kaynak and Aktaş (2017), and Yener (2020), such disparity can be attributed to the variations in authors, illustrators, and content featured in the analyzed books. However, the findings related to gender roles are particularly significant, especially when considering the treatment of the same subject matter in recent preschool children's books published abroad and the findings obtained from studies (Sunderland & McGlashan, 2012 and Lester, 2014; Sandercock, 2023; Tribunella, 2023).

In the study conducted by Başaran et al. (2021), an examination of a specific book in terms of the category of sexual elements exposed the inclusion of illustrations and textual representations featuring same-sex characters kissing each other on the lips. Sunderland and McGlashan (2012) posit that the representation of ideas related to homosexuality can provoke negative reactions when juxtaposed with social values that perpetuate the stereotypes of the majority. Accordingly, matters that cannot be categorically written and verbally described might be effectively implied through visual means, allowing for subtler communication. As elucidated by Deniz and Gözütok (2017), it is noteworthy that books encompass a dual realm comprising linguistic expressions and visual representations, both

of which hold the potential to either serve as foundational elements in the construction of gender stereotypes or offer explicit guidance and instruction pertaining to this particular subject matter. However, as Yıldız (2016) emphasizes, situations that will negatively affect the development of children's personalities should not be included in the books. Considering the outcomes derived from these studies, it becomes evident that the implicit messages in the books may not be as innocent as they seem; indeed, these implicit messages might be concealed behind explicit educational content. The topics in the books should provide children with universal values and contribute to the development of ethical values (Çatalcalı-Soyer, 2009). Therefore, careful consideration should be devoted to the meaning encapsulated within the content and communicated through linguistic and visual messages in children's books, encompassing both explicit and implicit connotations.

The criteria of textuality are important in linguistic messages. Linguistic errors involve elements that hinder consistency, such as interruptions in character or image flow within the text, or the utilization of varied grammatical tenses within the narration. The continuity of the narrative time is also important, as is the continuity of the subject and character. According to the findings of Başaran et al. (2021), children's picture books contain negative elements concerning form, content, theme, language and expression, hero-character, and time. The results obtained in this study align with the findings of Başaran et al. (2021). Translation errors further contribute to the lack of text consistency. This result also shows the necessity of emphasizing the cultural differences included in translated children's books, as proposed in the study by Güzelyurt (2020). Kansu Yetkiner (2010) states that in cases of conflict with target culture norms concerning content and quality in translated texts, problematic transfers should be removed, changes should be made in the choice of words, the tone of the discourse should be softened, the use of objectionable language should be removed, and the content that may be dangerous for children should be changed. Cognitive and linguistic developmental issues and the ability of children to understand foreign elements are central to the translation of children's literature; this is always a balancing act between adapting concepts in the target language to the level of understanding of the children and the level at which the children can understand. What is appropriate is to preserve the differences with the potential of the translated foreign text to enrich the target culture (O'Sullivan, 2013; 2019; 2021).

On the other hand, the outcomes of this study indicate that un-translating segments of the source text into the target language also constitute translation errors since, in this case, the objectionable content was overlooked by the translator rather than being intentionally removed. 80.00% of the books examined in the study are translated. Given that these literary works have received prestigious accolades and are frequently consumed by a young readership, it becomes imperative to underscore the paramount significance of their meticulous translation into the target language. This meticulous translation process is essential not only for ensuring linguistic fidelity but also for effectively transmitting the inherent educational quality and substance encapsulated within these acclaimed books. Moreover, such translation errors are considered unexpected and unusual in the most widely read and award-winning books.

Errors related to visual content encompass various unfavorable instances, including the selection of images incongruent with the principle of appropriateness for children, discrepancies between images and text, and inconsistencies among the images themselves. Inappropriate selection of images may negatively affect the cognitive

development of children, potentially changing their value judgments and behavior patterns. The images must be in parallel with the child's developmental level because visual text can maintain its relationship with the child as long as it provides ease of perception (Çer, 2016). It has been established that there are some images in the books that do not meet the principle of appropriateness for children. This result overlaps with the results of the study conducted by Gönen et al. (2014). Başaran et al. (2021) also note that among the prevalent negative features concerning form within the scrutinized books in their research, images constitute a significant factor. The convergence of similar outcomes in this study reinforces the need for increased attention to visual content. As one of the most important elements in children's books that appeal to the pre-school period, images allow the subject and plotline of the books to come to life in the minds of children. Verhallen and Bus (2011) have revealed that images in the books are effective in helping children understand the meaning of the text. Greenhoot et al. (2014) also emphasize the correlation between images and the processes of understanding and remembering. Gönen et al. (2016) further elaborate that children's initial interaction with books primarily occurs through images, followed by the integration of picture-text interplay.

The congruity between text and images is one of the most important features that picture story books should have (Martinez & Harmon, 2012; Nikolajeva & Scott, 2019; Sipe, 2008). The fact that the images do not overlap with the text can, to some extent, affect the word and concept development of children who perceive and interpret the text through images. Gönen et al. (2012) arrive at the conclusion that a substantial majority of the analyzed books pay attention to the image/text relationship. Başaran et al. (2021) emphasize the significance of ensuring coherence between the visual and textual content in children's picture books. The identification of disparities between images and texts in certain books aligns with the findings of previous studies exploring image-text congruence (Darga et al., 2021; Gönen & Aydos, 2013; Ertok Atmaca, 2006; İşcan & Cımbız, 2018), underscoring the importance of attending to image-text congruence. In alignment with the empirical observations delineated by Başaran et al. (2021), the present investigation corroborates that, within the domain of structural attributes, the textual-visual relationship emerges as one of the less frequently occurring adverse characteristics discerned throughout the comprehensive analysis of the examined literary works. It has been revealed that the image-text inconsistencies, which are few in the books, are mostly caused by translation errors. However, even though two of the scrutinized books with image-text incongruence are not translated books, it is evident that the content information and the image do not match. This circumstance emphasizes the need to thoroughly assess the texts in comparison with their visual content.

The evaluation of the preschool children's books examined within the scope of this study aligns with expert opinions. Books prepared for the pre-school period are important in terms of contributing to the psycho-social, cognitive, and linguistic development of children, as well as forming the basis for reading habits. As is the case with research conducted in this field, the current study aims to contribute to the scholarly debate. Nevertheless, it is advisable to consider broadening the scope of the database in future research to achieve a higher degree of generalizability. Additionally, a holistic and multidimensional approach is essential when dealing with books. Similar studies can be carried out for books addressed to different age groups. Moreover, the findings from this study could lay the groundwork for conducting more comprehensive and detailed research involving children as participants and within the context of preschool institutions.

Ethic

As the data collection and analysis in this study were carried out through the document analysis method using preschool children's books, the requirement for ethics committee approval is not applicable. Ethical regulations have been observed in the presentation of data and references in the study, and proper acknowledgement of the cited works has been provided.

Conflict of Interest

There is no conflict of interest in this research.

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YouTube-Assisted Listening Instruction (YALI): A Study of Listening Comprehension and Listening Anxiety of University Students of German as a Foreign Language

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Abstract

The present study aimed to investigate the effects of YouTube-assisted listening instruction (YALI) on the listening anxiety of students of German as a foreign language (GFL) and their listening comprehension performance. For this purpose, a total of ninety-six senior undergraduate students were equally divided into three groups using the criterion sampling technique: (a) YouTube-assisted listening instruction (experimental group); (b) traditional listening instruction with auditory materials (control group - 1); and (c) instruction without listening exposure (control group - 2). The instructional approach was underpinned by Richard E. Mayer's Cognitive Theory of Multimedia Learning (CTML). After a ten-week treatment process, results revealed that the students in YALI showed the best GFL listening comprehension performance compared to the control groups. In addition, YALI was observed to reduce students' GFL listening anxiety. Finally, a negative linear correlation between listening anxiety and listening comprehension performance was detected. This meant that students' listening anxiety decreased as their listening comprehension performance increased. To gain a better understanding of the effects of YALI on GFL listening comprehension performance and listening anxiety, relevant implications were discussed.

Key Words

Listening anxiety • Listening comprehension • YouTube

Introduction

Listening is one of the most complex language skills (Vandergrift, 2004) to be learned and mastered by foreign language (FL) learners (Graham, 2003), one that plays an active role in the internalization of language rules and the emergence of other language skills (Luu, Lian, & Siriyothin, 2021). Compared to the other basic language skills (reading, speaking, and writing), listening is primary channel that FL learners should use since the very beginning of their adventure of language learning (Bulut, 2019), and the fact that it is the first receptive skill developed by FL learners makes it an integrated skill (Harmer, 2007). However, due to phonological and lexical features such as invisible word boundaries, irregular pauses, false starts, and intonation patterns (Rahimi & Soleymani, 2015), many researchers (e.g., Berk, 2019; Chambers, 1996; Field, 2010; Luu et al., 2021; Lynch, 2009; Walker, 2014) have posited that teaching and learning listening as a language skill pose distinct challenges. Listening, especially in a non-native context, presents heightened difficulties for FL learners due to the need for control over speaking rate (Osada, 2004) and a reliance on lexical and contextual knowledge (Weber & Cutler, 2006). Moreover, spoken language differs from literary language (Berk, 2019), and even when spoken at a normal pace, run-on sentences and accent variances might make listening comprehension difficult for a FL student to understand (Buck, 2001). In such instances, a FL learner may suffer significant levels of anxiety and stress since he/she must not only understand but also respond to the speech (Vandergrift & Goh, 2012). FL learners with high anxiety levels lack self-confidence while listening in the FL context (Gregerson, 2003) and tend to be passive in classroom activities compared to their less anxious peers (Horwitz et al., 1986; Rahimi & Soleymani, 2015). As a consequence, a paramount affective factor influencing the progression of listening skills and the performance in listening comprehension is recognized as listening anxiety. In this regard, there is an urgent need to develop effective pedagogical strategies to increase foreign language learners' listening skills and reduce their listening anxiety.

Due to its complex nature, listening comprehension has received less attention in second or foreign language acquisition studies than other skills and competences (Bulut, 2019; Clement, 2007; Luu et al., 2021; Lynch, 2009). In this regard, Nunan (2002) compared listening abilities to "Cinderella, who is overshadowed by her siblings and constantly ignored by her family" (as cited in Berk, 2019, p. 39). The importance of listening skills in a second or foreign language has long been highlighted, and however, listening instruction in traditional classroom settings does not seem to enable FL learners to become effective listeners. Moreover, in today's world, English is the lingua franca across many domains (Luijkx, Gerritsen, & van Mulken, 2020) and most studies have naturally focused on research on English listening comprehension and listening anxiety. One of the salient observations to emphasize in this context is that individuals learning a foreign language (FL) or others, whether intentionally or inadvertently, encounter exposure to English language content through various mediums, including social media and other digital platforms. From this perspective, measurements of the effectiveness of learning environments and teaching materials in improving listening skills and listening comprehension performance in English may not yield the desired consistent results. Conducting similar research in the context of different languages can yield accurate and consistent results for the growing amount of FL listening literature. To this end, the current study directed its focus towards an investigation of listening comprehension performance and the presence of listening anxiety within the realm of German as a foreign language (GFL). In Turkey, as in many other countries, German is taught as a second foreign

language after English. Nevertheless, to the author's previous knowledge, the question of the extent to which GFL listening comprehension develops over time and how GFL listening anxiety decreases over time has not received much attention in Turkey or elsewhere. This study aimed to address this gap by conducting experimental research on the improvement of Turkish-speaking students' GFL listening comprehension performance and the reduction of listening anxiety in a learning context underpinned by Richard E. Mayer's (2009) Cognitive Theory of Multimedia Learning (CTML).

To achieve this, a training condition was designed to improve the students' GFL listening comprehension performance and reduce listening anxiety in a classroom setting through YouTube, which is an online video sharing and social media platform. YouTube has recently been one of the most regularly used multimedia tools in the classroom by educators because it is free and the most often logged-in platform for individuals for a variety of purposes (Heriyanto, 2015). In particular, research on YouTube has concluded that auditory and visual components are three times more effective than regular written texts in terms of retention time of vocabulary (Al Qasim & Al Fadda, 2013; Heriyanto, 2015; Kabooha & Elyas, 2018), increases students' motivation, classroom engagement and interaction (Callow & Zammit, 2012; Kabooha, 2016), and has positive effects on learner autonomy (Hafner & Miller, 2011). Based on the CTML, which proposes that multimedia enables individuals to form coherent mental representations between auditory and visual images and increases the functionality of the individual's brain, the current study suggests that YouTube may be the most appropriate educational tool to improve GFL listening comprehension performance and reduce listening anxiety. Via the utilization of YouTube, it becomes feasible to establish an authentic learning milieu within the classroom setting, facilitating heightened instances of foreign language (FL) learners' exposure to the target language. Such exposure, characterized by the simultaneous presentation of verbal and visual stimuli, holds the potential to enhance listening comprehension skills and mitigate listening anxiety.

Considering the research context, unlike previous studies, the present study focused on students who were learning German as a second foreign language after English and doing a BA program, with the exception of FL didactics, and the research design was different from other studies. Therefore, the study has two main aims to obtain the most meaningful results. First, it is to address the complex contours and controversial issues in the listening literature to raise awareness of listening comprehension and listening anxiety in the FL context by designing YouTube-assisted listening instruction (henceforth YALI) that differs from traditional classroom listening instruction, thereby promoting future collaboration among educators, linguists, and researchers. This will provide educators and researchers with analytical ideas for developing more systematic and better designed curricula for FL listening instruction in the future. Finally, the present study draws the reader's attention to the listening comprehension and listening concerns of GFL learners and offers innovative suggestions.

Literature Review

Listening Comprehension

The cognitive, emotional, and behavioral experiences that individuals acquire throughout their lives enable them to create perceptual filters to perfectly interpret listening in real-life contexts (Wolvin, 2018). In doing so, individuals

attach their own meaning to words, which in turn influences how they interpret incoming input during communication (Burley-Allen, 1995). In this way, listening comprehension is seen as an active process involving the interaction of multiple underlying sub-processes (Becker, 2016). Many researchers (e.g., Glenn, 1989; Luu et al., 2021; Nunan & Miller, 1995; Rahimi & Soleymani, 2015; Vogely, 1995, 1998; Witkin, 1990; Wolvin, 2018) have concluded that listening comprehension in a foreign language is a complex process with hundreds of variables. Moreover, it is still unclear what factors affect students' listening comprehension (Rahimi & Soleymani, 2015). Therefore, it is not possible to talk about a limited number of factors.

The length of the auditory materials played to the students in classroom settings and the fact that they include a lot of information may negatively affect be the quality of the listening skills of FL learners. If a FL learners' vocabulary is limited, he/she may not be able to retain all the information (Balkaya & Akpınar Dellal, 2022). However, listening comprehension can be successful if the instructor makes the necessary interventions, i.e., repeated listening. The instructor factor is crucial to conducting successful listening training (Tanir, 2020, 2022). This challenge becomes notably more pronounced in the context of conversational interactions between a foreign language (FL) learner and a native speaker. The learner cannot control and interfere with the speed of the speaker's speech (Lynch, 2009). Moreover, the speaker may use words that the listener does not know, and so, he/she may get stuck on the unfamiliar word and miss the next parts of the speech. In such cases, the listener may use non-verbal cues such as gestures, facial expressions, and intonations, which can lead to misunderstanding by speakers from different cultures (Berk, 2019; Underwood, 1989). Hence, it is imperative to underscore that achieving a heightened degree of proficiency in listening comprehension hinges not only on an extensive lexical repertoire but also on a nuanced grasp of contextual knowledge within the target language.

Moreover, FL research has revealed that individual factors such as level of education, age, gender, and general proficiency level have long-term effects on listening comprehension (Moyer, 2006). It has been found that students with high levels of language proficiency self-monitor themselves during listening tasks (O'Malley, Chamot, & Küpper, 1989) and consciously use their own strategies during listening. The listening comprehension performance of those with high language proficiency is higher than that of those with low language proficiency. On the other hand, it has been suggested that providing strategy training with visual input and word storming during listening instruction can result in high levels of comprehension and that multimedia and computer technologies can be useful interfaces for such activities (Gruba, 2004; Hulstijn, 2003; Moyer, 2006).

The aforementioned studies provide valuable insights into the factors that influence the listening comprehension of FL learners at different language levels and their intentions to use strategies during listening instruction. However, little has been shared about how to design listening instruction that is most appropriate for FL listening comprehension. It is also not clear to what extent university students' listening comprehension performance improves.

Listening Anxiety

FL listening anxiety was first introduced conceptually in 2000 (Kim, 2005; Ji, Qin, & Li, 2022). Previously, listening anxiety was conceptualized as a sub-dimension of the Foreign Language Classroom Anxiety Scale

(FLCAS) developed by Horwitz, Horwitz and Cope (1986). In this context, scholars and educators have found it reasonable to focus on one of the selected skills (listening, reading, speaking, and writing) when investigating the relationship between foreign language learners' performance and their anxiety (Zhang, 2013). Moreover, the FLCAS focuses more on speaking than other skills and has been used to measure communication anxiety, test anxiety, and fear of negative evaluation (Aida, 1994; Balkaya, Arabacıoğlu, & Çakır, 2020; Cheng, Horwitz, & Schallert, 1999; Li, 2022; Zhang, 2013). Therefore, it may not be sufficient to link language skills such as listening and reading in the FLCAS with FL performance (Zhang, 2013). Conducting an in-depth examination of the causal associations existing between anxiety and performance within a specific language skill domain may yield refined and precise metrics for assessing anxiety within that particular skill.

However, speaking in the FL context is often reported by learners as the most anxiety-provoking language skill (Horwitz, 2001; Phillips, 1992; Young, 1990; Zhang, 2013), and this may be the determining factor in the neglect of research on the effect of FL anxiety on listening comprehension performance. Moreover, many studies on FL listening anxiety have examined the relationship between listening anxiety and other affective variables such as motivation (Adnan, Marlina, Trisno, & Hutapea, 2021; Amiryousefi & Tavakoli, 2011; Bang & Hiver, 2016; Chow, Chiu, & Wong, 2018; Li, 2022; Liu & Yuan, 2021), self-efficacy (Arslan, 2017; Canaran, Bayram, Doğan, & Baturay, 2020; Fathi, Derakhshan, & Torabi, 2020; Mills, Pajares, & Herron, 2006), metacognitive awareness (Durmaz & Aşık, 2022; Xu & Huang, 2018), and engagement (Zhang, Dai, & Ardasheva, 2020). The findings indicated that language anxiety has a holistic effect on other affective variables (Gopang, Bughio, Memon, & Faiz, 2016; Horwitz, 2017; Lili, 2015; Liu & Huang, 2011; Mesri, 2012; Otair & Abd Aziz, 2017; Polat & Erişti, 2019; Xu, 2011). In this regard, it has been reported that the quality of instructional materials used (El Haj Hassan & Haj Hassan, 2018; Vogely, 1998), phonological features such as speaking rate, diction, and accent differences (Wilson, 2006), and learners' familiarity with the listening text (Lili, 2015) are factors behind FL listening anxiety. Nonetheless, it is noteworthy that a constrained body of research has documented instances wherein foreign language (FL) listening anxiety has exhibited no discernible predictive influence on listening comprehension outcomes (e.g., Bang & Hiver, 2016; Kim & Baek, 2017; Liu, 2016; Vafaee & Suzuki, 2020). Therefore, although it is accepted as a reality, there is no clear definition of the relationship between language anxiety and listening comprehension in the FL context.

Based on the research mentioned above, it is clear that there is a complex relationship between listening comprehension and language anxiety. It may be difficult to generalize from the vast majority of such research to the sources of listening anxiety for several reasons. First, almost all the relevant research addressed listening anxiety in English as a foreign or second language. Different results are likely to emerge in various FL contexts. Second, the FL perception of learners was English, and the instruments used to measure FL anxiety focused much more on English listening anxiety. As previously mentioned, contemporary foreign language (FL) learners frequently encounter substantial exposure to the target language, such as English, beyond the confines of formal educational settings, often through diverse online platforms. Consequently, the manifestation of FL anxiety may remain latent and pose inherent challenges in terms of its accurate measurement.

The Cognitive Theory of Multimedia Learning

Mayer's (2009) CTML is concerned with how multimedia instructional design affects the way the human mind works and how presented information is processed in the brain. Grounded in cognitivism, the theory draws on the information processing model of cognition (Ibrahim, 2012) and proposes memories that transform stimuli into information (Jonassen & Driscoll, 2013).

According to CTML, individuals learn deeply not only from words but also from the combination of words and pictures to form mental representations (Mayer, 2014). In doing so, it presents the vocabulary through learning contents composed of a combination of auditory and visual components such as animations, illustrations, pictures, photographs, or videos. The aim is to enable the learner to construct new knowledge by maximizing motivation and active participation. However, the main challenge of instructional design is how to encourage learners to engage in appropriate cognitive processing without the cognitive load that the capacity of the verbal or pictorial materials is likely to occur during learning. To overcome this problem, instructional materials and activities should be designed considering the minimum external load and the maximum intrinsic cognitive processing potential (Brünken, Plass, & Leutner, 2004). For this purpose, Mayer (2009) proposes five principles to reduce unnecessary cognitive processing in a multimedia learning environment: coherence, signaling, redundancy, spatial contiguity, and temporal contiguity principles. First, the coherence principle refers to increasing memory capacity by reducing external factors that interfere with the functioning of the mental process during learning (Sweller, 2010). Second, the signaling principle states that learners can learn better "when cues that highlight the organization of the essential material are added" (Jiang, Renandya, & Zhang, 2017, p. 729; Mayer, 2009). Third, the redundancy principle states that text and graphics in multimedia presentations cause visual working memory overload, and therefore auditory and visual animations integrate words and events in the mind more quickly and learn better with less cognitive processing (Mayer, 2009). Fourth, the spatial contiguity principle refers to the fact that physically integrating text and visuals allows students to retain learning inputs in working memory for a long time and increases the chances of active learning (Jiang et al., 2017). Finally, the temporal contiguity principle argues that the auditory and visual components of multimedia learning materials should be presented simultaneously.

Considering the general principles of CTML, YouTube may be a platform where audio and visual components are presented in the most effective way, and FL learners can experience listening activities individually anytime and anywhere. Moreover, it is user-friendly, free, and engaging, promoting language learning among learners (Yaacob, Amir, Asraf, Yaakob, & Zain, 2021). YouTube may increase students' potential exposure to the target language in terms of listening (Saputra & Fatimah, 2018). Therefore, the present study addressed YALI to improve university students' GFL listening comprehension performance and reduce GFL listening anxiety.

The Present Study

Based on some of the research gaps mentioned above, the current research focuses on two main areas in the context of listening, one of the four basic language skills: (a) the long-term gains of YALI in GFL listening

comprehension; and (b) its role in reducing anxiety in GFL listening. In line with these aims, different listening instruction approaches were designed by the author to test the effectiveness of the target listening instruction. To achieve the research objectives, the following questions were addressed in the present study:

(1) To what extent do the three different listening instruction approaches improve the students' GFL listening comprehension performance?

(2) To what extent do the three different listening instruction approaches improve the students' GFL listening anxiety?

(3) Is there a correlation between listening anxiety and listening comprehension performance?

Method

Research Design

The present study was conducted using a nonrandomized controlled trial design (or pretest-post-test study with two control groups), which is one of the quasi-experimental design types. Since it was not possible to assign students to the groups randomly according to this research design, the participants were assigned to the groups by the criterion sampling technique, one of the purposive sampling types. For this purpose, the students were assigned to three groups: (a) YouTube-assisted listening instruction (YALI) (EG: experimental group); (b) traditional listening instruction with auditory materials (CG1: control group-1); and (c) instruction without listening exposure (CG2: control group-2). Quantitative data were used for the measurements. The dependent variables were GFL listening comprehension performance and GFL listening anxiety, and the independent variable was YALI.

Participants

The participants were a total of 96 senior students (55 males and 41 females) who were doing a BA program in three different academic majors of the faculty of tourism at a technical university located in a city in the south of Türkiye. Their majors were gastronomy and culinary arts, tourist guidance, and tourism management, respectively. The criterion sampling technique was used to form the study group. In this regard, the German listening comprehension test (GLCT) was administered to a total of 117 students enrolled in the German III course. According to the test results, the German language level of 8 students was determined as A1, 96 as A2, and 13 as B1. Accordingly, 96 students with A2 level were included in the study, and 32 students were equally assigned to the three groups. Of the 32 students in the experimental group, 19 were boys and 13 were girls, 11 girls and 21 boys in CG1, and 15 boys and 17 girls in CG2. One-way ANOVA results showed that there was no significant difference between the GLCT pre-test scores of the three groups (F (2, 93) = 2.188, p = .118). The students' ages ranged from 22 to 24. Their mother tongue was Turkish.

Instruments

German Listening Comprehension Test (GLCT). In this study, GLCT was prepared by the researcher based on the listening texts on Lingua.com and used as a pre- and post-test to measure the students' listening proficiency in German. The GLCT consisted of six authentic passages and 30 questions (see Table 1). Each passage was performed

as monologues. The content of the passages covered a variety of daily routines. The average length of the passages was 2.23 minutes.

Table 1

Description of GLCT passages

Passage	Text title	Description
Passage one	Bei den Großeltern (With grandparents)	• Question Type: True-false (5 items) • Format: monologue • Length: 2.22
Passage two	Eine lange Reise (A long journey)	• Question Gap-filling (5 items) • Format: monologue • Length: 2.31
Passage three	Im Einkaufszentrum (In the shopping center)	• Question Type: Multiple-choice (5 items) • Format: monologue • Length: 2.15
Passage four	Im Wald (In the forest)	• Question Type: Multiple-choice (5 items) • Format: monologue • Length: 2.24
Passage five	Ein Tag im Schwimmbad (A day in the swimming pool)	• Question Type: Multiple-choice (5 items) • Format: monologue • Length: 2.28
Passage six	Jana geht zum Zahnarzt (Jana goes to the dentist)	• Question Type: Multiple-choice (5 items) • Format: monologue • Length: 2.19

The GLCT questions included three types of questions: true-false (5 items), gap-filling (5 items), and multiple-choice (20 items). The maximum score a student could get was 30. Each query carried a valuation of one point. To test the reliability of the GLCT items, the researcher conducted a pilot study with 48 students at the A2-level in aviation management. The validity and reliability measurements revealed that the GLCT showed acceptable internal consistency (Cronbach's $\alpha = 0.96$), indicating that the results had high reliability.

German Listening Anxiety Scale (GLAS). The GLAS in this study was a copy of the version of the Foreign Language Listening Anxiety Scale (FLLAS) by Elkhafaifi (2005) adapted by Zhang (2013) to measure foreign language anxiety in English listening classrooms. The FLLAS was originally a five-point Likert scale (range: 1= strongly disagree – 5 = strongly agree) and consisted of 20 items. The items were modified for this study to adapt them to listening anxiety in the context of listening in GFL classes. For example, the item "I get upset when I'm not

sure whether I understand what I'm hearing in English" was changed to "I get upset when I'm not sure whether I understand what I'm hearing in German." Their items were translated into Turkish, and the accuracy of the Turkish translation was checked by an English lecturer. The pre-test (Cronbach's α = .87) and post-test (Cronbach's α = 0.91) scores for the GLAS had acceptable internal consistency, and it means that the scale showed high acceptable reliability.

Treatment

General Information about GFL Courses at the Relevant Academic Program. GFL courses were taught as a second foreign language after English to the 3rd and 4th undergraduate students according to the regulations of the relevant academic program. At the end of a four-semester GFL course, it is hoped that students can acquire the main language skills (writing, reading, speaking, and listening) and use them successfully in their daily and professional lives. Furthermore, it is noteworthy that German as a Foreign Language (GFL) courses were aligned with substantial ECTS (European Credit Transfer and Accumulation System) credits, thereby necessitating a student's successful completion of GFL requirements as an integral component in the pursuit of a bachelor's degree.

In the scope of the study, the students in all three groups participated equally and fully in German Course III during the fall semester of the 2022–2023 academic year. They were taught by a single lecturer, used the same textbook, and performed the same tasks. During the research process, the groups were exposed to the three different GFL listening instruction approaches. The course lasted for two hours (45 minutes each) a week. The details are described in the following section.

Teaching materials. GFL listening comprehension instruction in EG was performed through videos delivered in the form of dialogue on YouTube. The videos were episodes of a mini-series entitled "Mein Weg nach Deutschland", and the length of each episode ranged from approximately seven to nine minutes. The mini-series was produced by the Goethe-Institute for teaching German to foreigners. All episodes are available on YouTube, and anyone who wants to learn German can access and practice listening anytime and anywhere via his/her PC or mobile device (e.g., smartphone or tablet PC) for free. Furthermore, the students also had the opportunity to watch the episodes with German subtitles. The texts for each episode were also available as PDFs to read along at the website of the Goethe Institute (http://www.goethe.de/mwnd/miniserie). This mini-series was chosen because it is set in a real-world context from the perspective of a non-native German speaker. In this way, the students would put themselves in the shoes of the character in the mini-series and experience in advance the listening comprehension and speaking difficulties they might face when they go to Germany.

However, listening activities for the students in CG1 were carried out through audio files of the textbook called Begegnungen Deutsch als Fremdsprache A2+: Integriertes Kurs- und Arbeitsbuch by Buscha and Szita (2013). The audio files, each of which varied in length from about five to eight minutes, were run on the author's laptop in the classroom. The listening texts were in the form of monologues and dialogues delivered for the purpose of reinforcing the relevant topics. Finally, those in CG2 did not conduct any listening activity. Worksheets were used in addition to the textbook.

GFL Listening Instruction Approaches. GFL listening instruction in EG and CG1 was carried out in a traditional classroom setting. The treatment covered a period of nine weeks for the groups and consisted of two phases: preparatory and main implementation stages.

Preparatory stage: This stage lasted one week, and two-hour sessions (45 minutes each) were conducted with students in both groups during their own class hours. In the first 45-minute session, problems in GFL listening were discussed and effective solutions and techniques to improve listening skills were verbally conveyed to the students. In this context, they were introduced to the author's five basic listening principles for being an active listener, inspired by Dale (1947) (see Table 2). In the second 45-minute session, these principles were modeled through a simple listening task to help them better manage and understand an effective listening process.

Table 2

General principles to promote GFL listening comprehension

Elements	The questions promoting GFL listening comprehension process
Concentration	(1) Focus on the speaker.
	(2) Do not let environmental factors distract you.
	(3) Analyze the speaker's body language.
	(4) Do not let your thoughts distract you.
Routation	(1) Use your own body language and gestures to convey your attention.
	(2) Route the conversation with your body language and gestures.
	(3) Show the speaker that you are listening.
	(4) Do not allow the speaker to use long and complex sentences.
Feedback	(1) Ask the speaker to repeat to avoid misunderstanding.
	(2) Repeat sentences or words you hear to get confirmation.
	(3) Periodically summarize the conversation.
Compliance	(1) Do not interrupt the speaker.
	(2) Pay attention to the pronunciation of words.
	(3) Stay in the context of the conversation.
Empathy	(1) Be open and empathetic in your response.
	(2) Assert your opinions respectfully.
	(3) Put yourself in the speaker's shoes.

Main implementation stage: This stage, which lasted eight weeks, started in the second week of the treatment. In the first lesson, EG students watched the episode of the relevant mini-series on YouTube related to the main topic of the weekly listening task selected from the relevant textbook in the classroom via a projector. To measure students' actual listening skills, the videos were released without German subtitles. Then, the multiple-choice and true-false questions about the events in the episodes were asked to the students. In the second lesson, the same episodes were

made to be watched with German subtitles. Afterwards, the students were asked to come together in pairs to form a group and to use their creativity to reenact the events about the related topic. The aim was to encourage learners to construct a coherent mental representation based on CTML, maximizing lexical and visual activity related to the events in the episodes. Thus, the negative impact of the intrinsic cognitive load on the long-term retention of listening comprehension and listening anxiety was to be reduced by synchronously sharing phonological features of words and contextual and lexical knowledge through auditory and visual components. On the other hand, CG1 students listened to the audio files of the textbook via the author's laptop in the classroom during the treatment process. The subject matter of the listening texts was similar to that in EG. In the first stage, the audio files were played as a whole. CG1 students were asked questions about the texts. Afterwards, the audio files were played in parts, i.e., sentence by sentence, and they were asked to orally repeat the German equivalents of the expressions that they caught. However, CG2 students were not exposed to any listening instruction. The lessons were conducted face-to-face in the classroom, as in the other groups. The dialogues in the textbook were acted out by CG2 students. In addition, worksheets were distributed to them for the reinforcement of relevant topics.

Procedure

Initially, in April 2022, the author obtained the necessary approvals from the Scientific Research and Publication Ethics Committee of the university to conduct the present study. Then, in May 2022, a pilot study was conducted with a small group to check the validity and reliability of data collection tools. The present study was carried out during the fall semester of the 2022–2023 academic year. In October 2023, a 45-minute meeting was held with the students to inform them about the purpose of the study. Students were told that participation in the study was based on voluntariness (All students fully participated in the study). Moreover, participants were duly apprised of the study's significance in the context of identifying efficacious strategies for enhancing their proficiency in German listening comprehension skills. Prior to the treatment, the GLCT pre-test was administered to the students to determine the study groups in the second week. After two days, the students completed the GLAS pre-test in about 40 minutes. In the third week, the students in EG and CG1 were instructed on the principles of being an active listener. From the fourth week on, the nine-week treatment process was conducted. After the treatment, the students in all three groups administered the post-tests of the relevant data tools. The research process for the present study lasted 13 weeks in total.

Data Analysis

The data were analyzed using SPSS 24 statistical software. The skewness and kurtosis coefficients of pre-test and post-test scores were examined to check the assumption of normality. Accordingly, the skewness coefficients for all dependent variables ranged between -.022 and .246, and the kurtosis coefficients varied from -.449 to .488, indicating that the data were normally distributed. To compare the pre-test scores in all three groups, a one-way ANOVA test was run. The statistical significance of within-subject (time: pre-test and post-test) and between-subject (group: EG, CG1, and CG2) effects and interaction effects (time × group) was examined by the repeated measures ANOVA test. On the other hand, a Pearson correlation analysis was performed to evaluate the correlation between listening comprehension performance and listening anxiety. The level of significance was set at 0.05.

Results

The Effect of YALI on GFL Listening Comprehension

Table 3 presents the descriptive statistics for the GLCT test results for each group (EG: YouTube-assisted listening instruction (YALI), CG1: traditional listening instruction with auditory materials, and CG2: instruction without listening exposure).

Table 3

Descriptive statistics for students' GFL listening comprehension

Time	EG		CG1	CG2		Total
	N	M (SD)	M (SD)	M (SD)	N	M (SD)
Pre-Test	32	10.09 (1.65)	10.21 (1.87)	10.93 (1.68)	96	10.41 (1.76)
Post-Test	32	19.81 (2.07)	16.09 (2.31)	14.09 (2.30)	96	16.66 (3.24)

As presented in Table 3, all three groups increased their mean scores on the post-test. Accordingly, EG1 showed the highest listening comprehension performance on the post-test ($M = 19.81$; $SD = 2.07$). This was followed by CG1 ($M = 16.09$; $SD = 2.31$). However, CG2 seemed to have the lowest performance ($M = 14.09$; $SD = 2.30$).

Next, the assumptions for performing the repeated measures ANOVA analysis were checked. Box's M test revealed that the covariances across the groups were equal, Box's $M = 2.404$, $F (6, 215559.692) = .388$, $p = .887$. Based on the results, Wilks' Lambda test was continued for further analysis.

Table 4

The repeated measures ANOVA results of students' GFL listening improvement

Source	df	F	p	Partial $\eta2$
Between subject effects				
Group	2	19.112	.000**	.291
Error	93			
Within subject effects				
Time	2	700.038	.000**	.883
Time × Group	2	64.946	.000**	.583
Error	93			

[***]$p < .05$

As shown in Table 4, results revealed that the time effect had a statistically significant effect on students' GFL listening comprehension performance, $F (2, 93) = 700.038$, $p < .05$, Partial $\eta^2 = .883$, large effect. This meant that students in each group improved their listening comprehension scores over time. Findings also revealed a significant effect of group (i.e., treatment), $F (2, 93) = 19.112$, $p < .05$, Partial $\eta^2 = .291$, large effect, indicating that the GFL listening comprehension performance among the groups differed statistically. Then, results demonstrated a significant interaction effect of time × group, $F (2, 93) = 64.946$, $p < .05$, Partial $\eta^2 = .583$, large effect. Figure 1 shows the time × group interaction effect for all three groups.

Figure 1

Interaction effect of time × group in the GFL listening comprehension
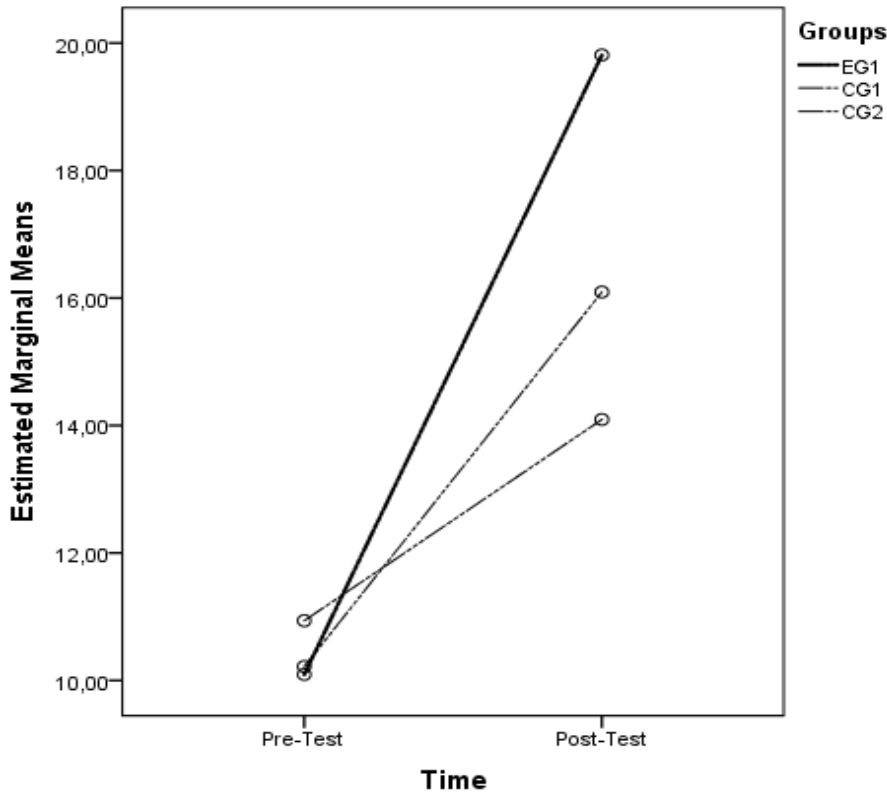
The Levene's Test of Equality of Variances indicated that the homogeneity of variances was achieved for the pre-test ($F (2, 93) = .523$, $p = .595$) and the post-test ($F (2, 93) = 301$, $p = .741$). Therefore, the Bonferroni Post Hoc test was performed for comparison of the groups. Bonferroni Post Hoc test on the post-test indicated that the listening comprehension performance of EG-students was significantly better compared to that of CG1 ($p < .05$) and CG2 ($p < .05$). In addition, no significant difference between listening comprehension scores in CG1 and CG2 on the post-test ($p = .361$) was detected although CG1-students outperformed those of CG2.

Overall, the findings revealed that EG exposed to YALI was more beneficial in terms of GFL listening comprehension performance compared to other instruction approaches. Moreover, CG1 performed better than CG2, but no statistically significant effect was observed.

The Effect of YALI on GFL Listening Anxiety

Table 5 presents the descriptive statistics of GFL listening anxiety depending on time and treatment. The mean scores on the pre-test were 3.49, 3.59, and 3.45, respectively, for EG, CG1, and CG2 students (SD = .63, .55, and .60), indicating that they had high levels of GFL listening anxiety. One-way ANOVA results also revealed that there were no significant differences across the groups on the pre-test (F (2, 93) = .490, p = .614).

Table 5

Descriptive statistics for students' GFL listening anxiety

Time		EG	CG1	CG2		Total
	N	M (SD)	M (SD)	M (SD)	N	M (SD)
Pre-Test	32	3.49 (.63)	3.59 (.55).	3.45 (.60)	96	3.51 (.59)
Post-Test	32	2.07 (.55)	2.56 (.62)	3.03 (.53)	96	2.56 (.69)

The repeated measures ANOVA was performed to determine whether there was a decrease in the GFL listening anxiety in the three groups. Beforehand, the assumptions for the analysis were checked. Box's M test revealed the equality of the covariances across the groups Box's M = 13.202, F (6, 215559,692) = 2.132, p = .046. For this reason, further analysis was continued with Wilks' Lambda test.

Table 6

The repeated measures ANOVA results of students' GFL listening anxiety decrease

Source	df	F	p	Partial η^2
Between subject effects				
Group	2	8.788	.000**	.159
Error	93			
Within subject effects				
Time	2	149.330	.000**	.616
Time × Group	2	14.021	.000**	.232
Error	93			

$^{***}p < .05$

As shown in Table 6, results revealed that the time effect had a statistically significant effect on students' GFL listening anxiety, F (2, 93) = 149.330, $p < .05$, Partial η^2 = .616, large effect. This meant that students in each group became less anxious about GFL listening over time. Results also revealed a significant effect of group (i.e., treatment), F (2, 93) = 8.788, $p < .05$, Partial η^2 = .159, large effect, indicating that the GFL listening anxiety among the groups differed statistically. Then, results demonstrated a significant interaction effect of time × group, F (2, 93)

= 149.330, $p < .05$, Partial $\eta^2 = .232$, large effect. Figure 2 shows the interaction effect of time × group for the three groups.

Figure 2

Interaction effect of time × group in the GFL listening anxiety
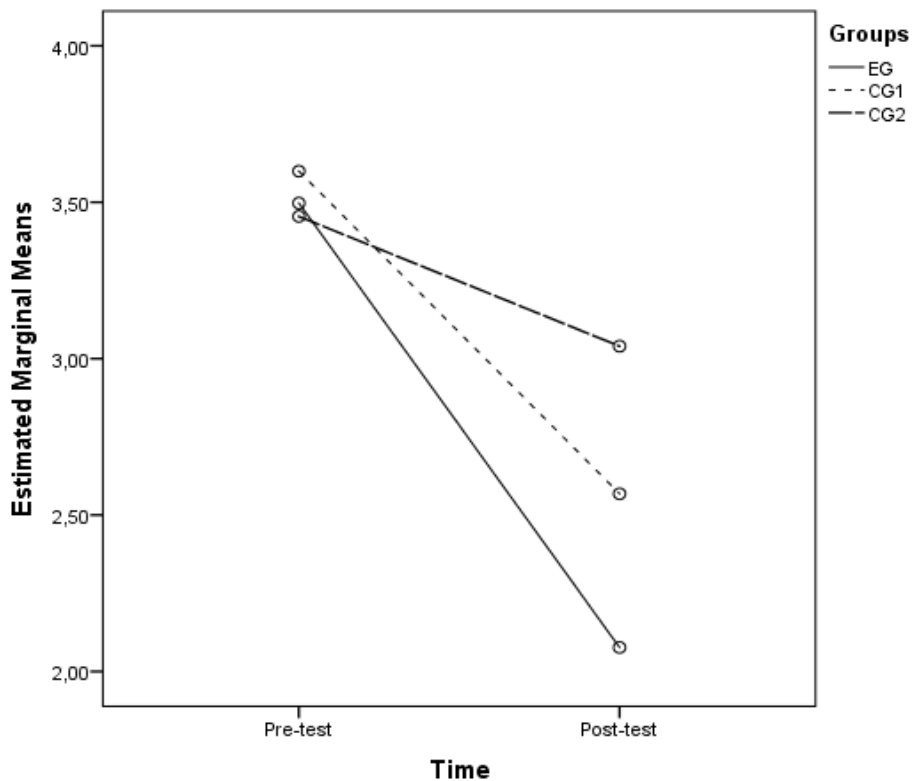
A post-hoc test was performed to compare the three groups in terms of GFL listening anxiety. Initially, the homogeneity of variances was checked. Levene's test did not reveal any violations for the pre-test ($F (2, 93) = .215$, $p = .807$) and the post-test ($F (2, 93) = .020$, $p = .981$). In this regard, the Bonferroni post-hoc test was preferred. The Bonferroni post-hoc test on the post-test revealed that the GFL listening anxiety levels of EG students were significantly lower compared to those of CG1 ($p < .05$) and CG2 ($p < .05$). In addition, CG1 students had lower levels of GFL listening anxiety than CG2 students, but no significant difference ($p = .437$) was observed between them.

The findings provided a better understanding of the overall reduction in GFL listening anxiety in all groups over time after treatment. The EG group had statistically the lowest anxiety compared to the two control groups. Consequently, it can be inferred that YouTube yielded a favorable impact in diminishing the levels of listening anxiety experienced by the students.

Correlation between Listening Anxiety and Listening Comprehension Performance

Pearson's product-moment correlation coefficient was calculated to assess the relationship between students' GFL listening anxiety (LA) and listening comprehension performance (LCP). The results are presented in Table 7.

Table 7

Correlation between listening anxiety and listening comprehension performance in GLCT

Variables	Correlation (LCP and LA)
Pre-test	$r = .033$ ($p = .749$)
Post-test	$r = -.384$ ($p = .000$)

*** *$p < .001$*

Prior to the treatment, a positive correlation between students' GFL listening anxiety and listening comprehension performance was detected, but this relationship was not significant ($r = .033$, $p = .749$). After the treatment, results revealed that there was a linear negative and significant correlation between students' GFL listening anxiety and listening comprehension performance *($r = -.384$ ($p < .001$).* That is to say, if a student's listening anxiety decreases, his/her listening comprehension scores will increase.

Discussion

Primarily, the present study aimed to carry out a comparative investigation of the effects of YALI on the GFL listening comprehension performance of the students at A2 level and their GFL listening anxiety. In the context, three different listening instruction approaches were proposed in the study: YouTube-assisted listening instruction (YALI) (EG), traditional listening instruction with auditory materials (CG1), and instruction without listening exposure (CG2).

Regarding the first research question, after only ten weeks of treatment, the results revealed a significant increase in GFL listening comprehension scores in all three groups. However, the listening comprehension scores of EG students exposed to YALI were statistically significant compared to those in the two control groups. This suggests that YALI seems to be a feasible and effective approach to improving students' GFL listening comprehension. These findings of the study were in line with those of previous studies (Al-Alwan, Asassfeh, & Al-Shboul, 2013; Nomass, 2013; Yaacob et al., 2021), which found that using video podcasts via YouTube in traditional classroom settings had a statistically significant effect on students' FL listening comprehension development. The present study also confirmed the previous studies (Etemadfar, Soozandehfar, & Namaziandost, 2020; Hosseini & Mahmood, 2021; Namaziandost, Neisi, & Momtaz, 2019; Shahnama, Ghonsooly, & Shirvan, 2021; Qiu & Luo, 2022; Vaezi, Afghari, & Lotfi, 2019; Xiaoyan, 2018), which reported that flipped-classroom instruction had a positive effect on the FL listening skills of the students highly exposed to authentic listening materials in the classroom. One of the most important findings of the present study was that there was no statistically significant difference between the GFL listening comprehension scores of CG1 students who received listening instruction through the audio files of the textbook and C2 students who were not exposed to any listening activity. These findings of the study were in line

with those of previous studies (Abidin, Pour-Mohammadi, Souriyavongsa, Tiang, & Kim, 2011; Vandergrift, 2007; Yaacob et al., 2021), which indicated that audio files did not lead to significant improvement in students' FL listening comprehension performance and FL listening skills, even though the tasks and activities provided were appropriate for their language proficiency levels. One possible reason that explains this finding may be that the students' internal cognitive load may have increased because of their inability to organize the events described in the audio files they listened to in class into a coherent cognitive representation in their minds, and as a result, they may have had difficulty in understanding what they listened to. In addition, the cognitive overload due to the design and functional characteristics of the audio files may not have guided students' existing lexical and contextual knowledge to comprehend what they listened to. Hence, it can be posited that YouTube-assisted listening instruction (YALI) potentially augments learners' acumen pertaining to micro-listening skills, including the ability to adapt to diverse pronunciation nuances and discern intricate intonation patterns. This differential advantage in comparison to conventional audio-based language pedagogies has been noted in the work of Waring (2003). Furthermore, the mitigation of cognitive overload, which emanates from the inherent complexity of information processing, as expounded by Sweller (2010), can be achieved through the integration of visual and auditory stimuli within listening comprehension tasks. Consequently, this amalgamation holds promise in optimizing students' foreign language (FL) listening comprehension performance. Therefore, the present study suggests that YALI can help students be aware of their own potential while listening to speakers of the target language and improve their FL listening skills by minimizing the internal and external cognitive overload caused by the complexity of instructional activities and materials, which is one of the most important barriers to learning according to the CTML.

The results related to the second research question revealed that YALI reduced students' GFL listening anxiety. These findings of the present study were consistent with those of previous studies that reported that doing listening activities through mobile devices (e.g., smartphones and tablet PCs) (Chinnery, 2006; Evans, 2008; Kim, 2018; Rahimi & Soleymani, 2015), online collaborative learning programs (Magen-Nagar & Shonfeld, 2018), and the flipped classroom method of instruction (Abdolrezapour, 2019; Lai & Hwang, 2016; Qiu & Luo, 2022) had a significant effect on reducing students' FL listening anxiety. A possible explanation for this may be that students' other basic (reading, speaking, and writing) and supportive skills (grammar, vocabulary, and pronunciation) compared to their listening skills improved during the treatment process. This conclusion is supported by previous studies (Elkhafaifi, 2005; Liu, 2016; Liu & Xu, 2021; Zhang, 2013), which suggested that students' FL listening anxiety decreased as their general foreign language learning anxiety decreased. Another possible explanation may be that the length of exposure to the target language through authentic listening materials delivered on YouTube reduced students' GFL listening anxiety. However, this finding of the study contradicted that of Hwang, Hsu, Lai and Hsueh (2017), which found that the problem-based computer game designed by themselves did not reduce the English listening anxiety of the students with an average age of 15. The contradiction between the studies may be explained by the fact that the issue of FL listening anxiety may not only be a general FL learning anxiety but also exist in the context of technology-based language learning. Moreover, the participants were in the adolescent period, when physical and mental development take place at the same time, considering their average age. Therefore, their attitudes towards not only FL listening anxiety but also the FL learning process as a whole and their perceptions

towards learning through computer games may have an impact on the increase in FL listening anxiety depending on various internal and external cognitive factors. Another noteworthy discovery in the present study revealed a lack of statistically significant differentiation between the levels of German as a Foreign Language (GFL) listening anxiety exhibited by students in Control Group 1 (CG1) and Control Group 2 (CG2). The reason why the GFL listening anxiety of CG1 students did not decrease statistically can be explained by the fact that the students felt isolated in the classroom and could not gain learner autonomy because the procedure of listening to the audio files and implementing the activities was carried out under the control of the instructor. The previous studies, which revealed the positive effect of YouTube on students' motivation and autonomous learning in foreign language learning (Callow & Zammit, 2012; Hafner & Miller, 2011; Kabooha & Elyas, 2018) and the effectiveness of the individual, collaborative, and interactive nature of the flipped classroom method of instruction on students' FL listening anxiety (Eryılmaz & Cigdemoglu, 2019; Lai & Hwang, 2016; Qiu & Luo, 2022; van Alten et al., 2019) supported this conclusion. Therefore, the present study suggests that anxiety is a cognitive and latent factor, and that YALI is a feasible and effective approach to helping students overcome FL listening anxiety by reducing the cognitive overload that may be caused by external factors during the listening process.

Regarding the last research question, the results revealed a negative linear relationship between GFL listening anxiety and GFL listening comprehension performance. The findings of the present study were consistent with those of previous studies (Brunfaut & Revesz, 2015; Cheng et al., 2014; Dalman, 2016; Liu, 2016; Liu & Thondhlana, 2015; Lucas, Miraflores, & Go, 2011; Liu & Xu, 2021; Qiu & Luo, 2022; Shu-Yan & Cha, 2019; Valizadeh & Alavinia, 2013; Xu & Huang, 2018; Yamauchi, 2014; Zhang, 2013) indicating that there was a significant negative relationship between FL listening anxiety and levels of listening proficiency. Therefore, this meant that a student with a low level of FL listening anxiety improved his/her FL listening comprehension. Based on this evidence, the present study suggests that YALI captures the perfect harmony of auditory and visual components, which provokes students to retain in their long-term memory what they have learned by forming mental representations of the events in the target listening tasks in the form of a sound-image-word spiral. Thus, the students can make sense of an unknown word and its pronunciation by capturing clues from the previous auditory associations in their minds, and their levels of FL listening anxiety may decrease. In addition, it can be argued that authentic learning, i.e., real-life episodes presented through YouTube, minimizes the intrinsic cognitive overload caused by the complexity of learning materials by inferring from students' own lives. This assertion finds support in Mayer's Cognitive Theory of Multimedia Learning (CTML) from 2009, which posits that an individual's capacity for verbal and visual memory is inherently selective and, moreover, does not permit concurrent focus on multiple audio-visual materials or textual inputs. Therefore, YouTube may maximize students' intrinsic cognitive processing potential during listening and reduce students' FL listening anxiety during listening tasks or oral communication with speakers of the target language. This inference was supported by Vogely (1998), who indicated that the vocabulary capacity of a student can induce FL listening anxiety. For example, a student constantly focuses on the word when he/she hears a previously unfamiliar sound during listening, and this may lead to a lack of listening comprehension (Zhang, 2013). However, the findings of the present study contradicted those that classroom anxiety based on the flipped classroom model did not cause any change in students' FL listening performance (Hosseini & Mahmoodi, 2021), that the level

of FL anxiety did not decrease with the increase in language proficiency (Saito & Samimy, 1996), and that test anxiety had no statistical effect on listening test performance (Aida, 1994; In'nami, 2006; MacIntyre & Gardner, 1989). A possible explanation may be that classroom and test anxiety is related to general learning anxiety rather than FL listening, which may have led to manipulative results due to students' tendency to answer the items of the scale beyond FL listening anxiety. Therefore, the fact that listening skills are a less studied area compared to other language skills may cause many questions to remain unanswered in the context of FL listening anxiety and FL listening comprehension performance.

Conclusion

The present study offers a number of theoretical and practical implications. First, it was found that YALI was successfully integrated into the GFL listening course and improved students' listening comprehension. Theoretically, this is in line with CTML, which states that multimedia teaching materials represented in words and pictures help students learn deeply. Therefore, the relevant educational tools should be focused on maximizing intrinsic cognitive processing, considering the selectivity of individuals' verbal and visual perceptions, and their use in traditional classroom settings to improve students' FL listening comprehension performance should be encouraged.

Second, YALI created an effective authentic learning environment where students could be intensively exposed to GFL and, as a result, reduce their GFL listening anxiety. Although it led to a decrease in the levels of students' listening anxiety, the current instructional approach should be considered as a complementary method rather than an alternative to traditional learning. This phenomenon can be attributed to the pivotal role played by instructors in enhancing the efficacy of German as a Foreign Language (GFL) listening courses. They are therefore role models and are at the center of learning and creativity. In this regard, they need to know the reasons behind students' FL listening anxiety and have the competence to prepare effective listening materials by taking preventive measures.

Finally, the present study concluded that GFL listening anxiety has a significant impact on students' listening comprehension. A high level of listening anxiety is an important factor that causes students to underperform in GFL listening comprehension. Therefore, the selection and design of listening activities should avoid using videos with a lot of written text that may cause cognitive overload. During listening, students focus on the words rather than the sound and thus have difficulty following the phonetic discourse of the words, such as intonation and pronunciation. Similarly, learners may encounter difficulties in their listening process when encountering an unfamiliar word, leading to a state of being ensnared by this lexical unfamiliarity and subsequently disengaging from the broader contextual understanding of the listening material.

In conclusion, YALI can be an alternative method for developing listening skills that have been neglected due to their complex nature. Although the present study was conducted with undergraduate students in the GFL context, the approach used in the design of the study can be adapted to research on FL listening skills development anywhere in the world.

Limitations and Suggestions for Further Research

The present study suffered from some limitations. In this regard, the study also offers several suggestions for directions for further research. First, it provides some preliminary evidence on the effect of YALI on students' listening anxiety and listening comprehension performance in the classroom, with particular emphasis on its effect in the GFL context. Therefore, it should be replicated in different language contexts to confirm the present findings. Second, the participants in the study were all at the A2 level. It would be interesting to include data from learners at different levels of language proficiency on the effectiveness of YALI as a potential instructional approach for improving FL listening comprehension performance and reducing FL listening anxiety. Third, gender was not considered as an independent factor in the present study. Gender may have an impact on the research results, and further research could investigate the effect of gender. Finally, all participants were of Turkish origin, and their number was limited. It is possible that similar results may or may not be found among students from different ethnic groups. In summary, further research in this context is recommended.

Ethic

Prior to data collection, ethical approval was obtained from the Ethics Committee for Scientific Research and Publications of Iskenderun Technical University dated 09.05.2022 with resolution number 2022-57973.

Author Contributions

The whole process of the research was conducted by the researcher.

Conflict of Interest

The author discloses that there is no conflict of interest.

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Examining Students' Thoughts on Climate Change in the Context of Basic Concept

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Abstract

In this study, our aim was to investigate the beliefs of middle school students about climate change. We conducted study with 183 secondary school students. Within the scope of the study, students were asked two questions about climate change, and written responses were analyzed using an embedded a mixed-method approach. The questions posed were: (1) What is the cause of global warming? (2) What factors influence the climate? Based on the results of the quantitative analysis of the participants' responses, the answers to the first question were "human," "greenhouse effect," and "Earth." The concepts of "pollution," "atmosphere," and "Earth" are used in the second question. As per the qualitative analysis results, the students' responses focused on three elements: "living things, Earth, and atmosphere." The students responses to the second question reveal a more specific or general attitude. The findings indicate that students view climate change not merely as an isolated phenomenon but as a complex system influenced by various components. It is also suggested that students have an understanding of the distinction between weather and climate. The ability to connect climate change with social issues may encourage individuals to make greater efforts in mitigating its effects.

Key Words

Climate literacy • Climate change • Beliefs of middle school students

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Introduction

Enhancing society's knowledge about climate change is a paramount goal for this situation, which affects all living things in the world. Achieving this awareness goal is crucial and the approach taken to achieve it is equally vital. Considering that education plays an important role in preserving natural balances, this process should not be limited to schools (Merenlender et al., 2016; Olander and Olander, 2017; İbret, Demirbaş and Demir, 2019). This situation shows the importance of climate literacy. As Laugksch (2000) states, a sub-dimension of scientific literacy is awareness of the impact of science on society. On the other hand, the ecological footprint method is used to understand the connection between social and personal impact on climate change (Cordero, Todd, and Abellerra, 2008). "The relationship between education and the environment is deeply interconnected, forming a mutually beneficial partnership that plays a critical role in shaping a sustainable future. In a world grappling with increasingly complex environmental issues, it becomes ever more evident that education is a cornerstone in enhancing environmental consciousness, advocating for sustainable behaviors, and empowering individuals to take on the role of responsible caretakers of our planet (Shutaleva, 2023).

Education serves as a potent instrument for raising awareness about urgent environmental concerns. By integrating environmental topics into educational curricula across various levels, institutions of learning can furnish students with the knowledge and insight needed to grasp the consequences of human activities on the natural world. Educators have the opportunity to underscore the significance of key concepts like climate change, biodiversity decline, pollution, and resource depletion, thereby ensuring that students recognize both the immediacy and potential ramifications of these issues (Stevenson et al., 2014).

Education carries the potential to spark systemic transformation by influencing public opinion, shaping policy development, and inspiring collective action. Educational establishments contribute significantly to broader societal shifts toward sustainability by educating forthcoming generations on environmental challenges and the principles of sustainable living (Sterling, 2004).

This perspective has been used to draw attention to students' biological capacities in nature, as well as the connection between resources and demands in the natural world (O'Gorman and Davis, 2013). Burkholder et al. (2017) conducted a study examining the effects of climate change-oriented curriculum on undergraduate students in higher education.

Therefore, the purpose of our research is to elucidate students' attitudes towards climate change, aiming to gain a deeper understanding of how education can drive behavioral changes and enhance comprehension of climate change. We also aim to emphasize that fostering scientific literacy and climate literacy can significantly contribute to utilizing climate change insights for making informed decisions about the future.

Scientific Literacy

Scientific literacy is regarded as an essential factor in preparing the next generation to be responsible for achieving long-term growth (Kurbanoğlu, 2010). Information literacy refers to a concept that covers the dimensions of obtaining, evaluating, and sharing information (Andretta, 2007). Understanding what climate change is, what

changes we can make as a society, accepting the responsibilities of our actions, and reducing the damage we do to the environment are important issues for humanity. The concept of scientific literacy emerged in the late 1950s and has been expanding since it was defined by Paul Zurkowski in 1974 (Bybee, 2015; Kurbanoğlu, 2010). The focus of this study is climate change, which students often encounter in different environments and sources in schools and outside school.

Climate Literacy

Unexpected changes in the average or usual weather cycle of a particular city or region are called climate change (Türkeş, 2001). For example, it is the noticeable change in annual average precipitation and temperatures in a certain season (Öztürk, 2002). Reducing the impact of climate change is possible with the participation of all segments of society in the measures taken and practices (Stevenson et al., 2014). This can be achieved by informing and raising their awareness. For this reason, it is very important to educate students, who are the adults of the future and constitute an important segment of society, on this subject., Shepardson et al. (2012) conducted a study with secondary school students in this context and examined how students conceptualized climate change. They determined that students thought that global warming only affected air temperatures and that they had difficulty distinguishing between climate change and global warming. They could not distinguish the effects of global warming in different climates and the difference between weather and climate. However, it was also revealed that students understood the relationship between the carbon cycle and the greenhouse effect. Cordero et al. (2008) conducted a study on 400 university students and determined that, as a result of lessons on climate and weather, students showed greater awareness of climate change than before the study.

After all this, it becomes clear that climate change literacy, which is a sub-version of scientific literacy, is important and that studies on this subject need to be done. Here, science literacy teaches individuals basic concepts related to climate change, such as energy cycles, greenhouse effect, temperature changes, sea level rise, and climate models. These concepts provide a basis for understanding and discussing the phenomenon of climate change, helping individuals understand the reliability and validity of information about climate change and make informed decisions. Climate change literacy involves understanding the natural sciences, particularly fields such asatmospheric science, oceanography, meteorology, and environmental science. Therefore, knowing about climate change requires an understanding based on these scientific foundations. As a result, science literacy plays a fundamental role in acquiring, evaluating and understanding information about climate change. Climate change requires people to understand the world and environmental changes more deeply. Therefore, science literacy is an important component in the fight against climate change. In light of all this information, the research question of this study was determined by the researchers as follows: "How do the educational experiences of middle school students shape their beliefs about climate change?". Our main purpose in this study is to investigate the perspectives of secondary school students, who are considered the adults of the future, on climate change.

Method

In this study, the effect of students' educational experiences on their beliefs about climate change was examined. In this study, where mixed methods were used, the integration of qualitative and quantitative data was examined.

Detailed analysis of quantitative and qualitative data was carried out in order to analyze the questions asked to students about climate change in detail. Data were collected and analyzed through open-ended questions. Detailed information about this is included in the subheadings below.

Participants

This study involved 183 eighth-grade students continuing their education in a provincial center in the Western Black Sea Region. The participants of the study take science courses that form the basis of university-level education in natural sciences, mathematics, and technology (MEB, 2018). Participants were selected on a voluntary basis with the consent of their families. 30% (54) of the students receiving education lived in rural areas, while 70% (129) lived in urban areas. The participants were selected randomly from five different classes. Choosing the source for data in a research is important in terms of the representativeness of the research results and their meaningfulness for similar groups or environments (Yıldırım and Şimşek, 2013). In this context, the evaluation of the results obtained from the participants was handled both from a general perspective and independently of each other. However, factors such as students' socioeconomic backgrounds, gender, or academic achievement levels were not considered. Among the study participants, 85 were girls, and 98 were boys.

Data Collection and Analysis

In the data collection phase, two open-ended questions were given to the students and they were asked to answer them. The questions were developed by the researchers and expert opinions were taken for their reliability and validity. Question 1 (Q1) was asked in a defined form: 'How would you describe climate change? Discuss as many possibilities as you can. Question 2 (Q2) concerned the reasons for climate change: "What influences the climate?" Discuss as many possibilities as you can. The data were analyzed utilizing an embedded mixed-method methodology (Ilgar& Ilgar, 2013). In addition, this data set was used to quantitatively analyze the word-forming frequency in a quality design to identify the meaning between answers to two questions by students.

A qualitative and quantitative analysis of the responses was carried out. During the research process, students' awareness of climate change was examined to establish educational guidelines on climate-related sustainability initiatives. The quantitative research includes critical details such as the frequency of word usage in students' responses. This process was carried out using the "Word Analysis Tool" of Text Finder (2007) Qualitative analysis was supported by identifying the major categories that stand out in the students' answers. Qualitative analysis was carried out to determine the principal subjects and subgroups characterized in the students' answers. The answers to the two questions were first read to the students many times separately by each of the two researchers. It was then used to examine qualitative discrepancies in students' perceptions of climate change across the major identified categories. These sets of meanings are also verified according to a framework developed by Shepardson et al. (2012). Here, he defines conceptual elements to contextualize climate change. This study's conceptual structure is focused on students' interpretation of the climate system. This comprises some notional components that have been used to describe the climate system, such as "climate, weather, energy, feedback, Earth, sun, atmosphere, ice, oceans, and vegetation". Each element encompasses the three-stage level, which refers to a progression from the least advanced to the most advanced understanding of another. For example, 'feedback' is a conceptual element of climate change,

and this event that occurs in nature is feedback given by nature to human or environmental factors. As stated by Shepardson et al. (2012), changes in the sun, atmosphere, oceans, ice, soil, and vegetation are the principal reasons for the change in the Earth's climate system, and these changes can occur for natural or human reasons. According to the same study's findings, human actions such as the use of coal and oil and the loss of forests can also contribute to climate change. In addition, a clear sense of the effects of changes in these systems on the general climate is associated with feedback from other constituents of the climate system. According to the findings of the same study, it was determined that changes in conceptual elements in the same category, but at the third level, can destabilize the system and even give rise to Earth's orbit changing. It has been stated that human activities such as solar flares, natural changes in the Earth's climate, the use of fossil fuels, and the loss of forests may also be reasons for the change in the climate system. The clear impact of these changes on the overall climate will be associated with feedback from other constituents of the climate system.

An embedded mixed approach in this study (Ilgar and Ilgar, 2013) was applied. As a result, the same data set was subjected to both quantitative and qualitative analyses. The students' submitted responses were evaluated by revealing the main themes in the responses. We then subjected the themes to further qualitative analysis of what climate change is. The system established by Shepardson et al. progressed from the least advanced responses to the most advanced responses in this study. The quantitative analysis findings revealed three major categories connected to the reasons for climate change. We also looked at these themes to see if there were any contextual variations in students' beliefs.

Findings

Descriptive Findings

Quantitative analysis results indicate that the 183 student responses contained 12,286 words (m = 89.53) for the first question and 12,491 words (m = 92.21) for the second question. Of the 24777 words obtained from the students' responses, the most used word is "Earth" 142 times (0.7%) (Table 3). During the analysis phase, renditions and conjunctions such as "and", "with", "if", and "this" and repeated words in the questions are excluded. As shown in Table 1, the three most commonly used words to respond to the first question were 'human,' 'greenhouse effect,' and 'Earth,' while Table 2 indicates that the most frequently used words to address the second question were 'pollution,' 'atmosphere,' and 'Earth.

The word 'Earth' is the most frequently used term to describe climate change. This can be attributed to the 'greenhouse effect,' which leads to the melting of glaciers and rising temperatures. Furthermore, words such as 'air pollution,' 'pollution,' 'atmosphere,' and 'greenhouse gases' are commonly used terms associated with the causes of climate change. As a result of the analysis, it was revealed that "greenhouse effect", "heat" and "air pollution" are often used by students to express their understanding of climate change. According to the results of the quantitative analysis, the main categories in the students' responses are 'Humans,' 'Earth,' and 'Atmosphere' (including the greenhouse effect).

Table 1

Frequency of words derived from students' answers to the first question

Word	Frequency
Human	%72
Greenhouse Effect	%32
Earth	%31
Melt	%29
Heat	%26
Hot Air	%24
Animals	%23
Atmosphere	%18
Water Supply	%16
Air	%16

Table 2

Frequency of words derived from students' answers to the second question

Word	Frequency
Pollution	%48
Atmosphere	%41
Earth	%37
Air Pollution	%35
Greenhouse Gases	%31
Radiation	%29
Heat	%26
Sun	%25
Human	%20
Nature	%19

Table 3

Frequency of total answers to students' first and second question

Word	Frequency
Earth	%77
Human	%66
Greenhouse Effect	%65
Heat	%63
Air Pollution	%60
Pollution	%57
Sun	%55
Atmosphere	%42
Animals	%32
Melt	%32
Nature	%31
Radiation	%30
Agriculture	%27

Findings of Qualitative Analysis

The first qualitative question was examined from the most sophisticated to the most advanced interpretation of climate change. "Living things (humans or animals and their effects on climate change), Earth (reasons and conclusions), and atmosphere (causes or consequences)" are the categories that arise from the quantitative analysis of the second problem. This situation is clearly seen when Table 2 is examined. Here, the word 'pollution' was expressed most frequently with 48%. Later, the word 'atmosphere' emerged from the students' statements with a rate of 41%. Thirdly, the word 'earth' was used frequently by the students with a rate of 37%.

An analysis of the students' answers to the first question revealed their different interpretations. We analyzed these results based on the "conceptual elements" framework developed by Shepardson et al. (2012). There are some differences in the explanations of the students. Here, especially between the first and second questions, the word world is seen to be in the third place among the most frequently used words by the students. The fact that the word world was among the most frequently used words with a rate of 31% in the first question and 32% in the second question also shows that our study differs from other studies in the literature. While human aspects are prioritized in some explanations, aspects related to the natural environment are pushed into the background or not mentioned at all. Some statements did not give any views on which factors are affecting climate change. Student 2 stated the following about this finding: '*Temperature and weather patterns can cause climate change. On average, this change is in months, and this is the change in a general year.*'

Shepardson and others supported this view (2012). In his study, he stated that the air and atmosphere are in daily conditions and stated that the average temperature, precipitation, humidity, and wind conditions for long periods make up the climate.

While discussing natural changes, the student mentioned below did not delve into the root causes of climate change. Nevertheless, this student has a pessimistic attitude about climate change: '*Recent excessive climate changes have affected the natural environment and our world. Especially in recent years, extraordinary weather events in different geographies of the world and the rapid melting of glaciers have caused the effects and extent of global climate change to be felt. As global warming increases, polar ice caps melt. As glaciers melt, the Earth's water content increases, increasing the likelihood of flooding, and even some land conditions occur underwater. This can lead to people being homeless or even unable to farm. Climate change: The puncture of the ozone layer also causes the spread of bad and harmful gases into the atmosphere, the passage of the sun's rays to the earth without filtering, and the rays become very harmful.*'

This section corresponds to the conceptual elements described in the third level by Shepardson et al. (2012). In their study, the researchers asserted that the atmosphere's daily conditions (in the troposphere) encompass aspects such as temperature, precipitation, humidity, and wind. From these conditions, the climate must be long-term average and variable. He stated that climate differences occur globally because of changes in the climate system and at different time intervals.

Several responses also assessed natural climate change in the pace's context of change: '*The climate can constantly have some minor changes. Climate change consistently ranks among the fastest changes that have negative impacts on the world.*'

Finally, several responses include the different causes of climate change, the temporal aspect without attribution to them: '*One of the world's biggest problems is climate change. Air temperature or low temperature increases because of changes. As weather changes become more extreme, people use air conditioning, which brings up climate change more globally. As global warming increases, polar ice caps melt. As glaciers melt, the Earth's water content increases, increasing the likelihood of flooding. This causes ecosystems to deteriorate. Because of the deterioration of the climate, plant, animal, and soil yields decrease, and natural resources are depleted. Animals whose natural habitats are changing cannot adapt to their environment and as a result, are extinct.*'

The student who defines a conceptual aspect at level three in the following excerpt not only describes climate change but also analyzes and focuses on each individual's impact on climate change. Natural modifications are often accepted by the student: '*Changes in climates, deterioration, and differentiation of the climates of different regions of the world over time, destruction of water resources means climate changes. We can also express changes in the atmosphere as a result of the chemicals used today as the Earth warms, and the air temperature is below or above normal. Changing climates means changing seasons. It is a destabilization of the natural balance. Melting glaciers, extreme temperatures or extreme cold seasons, and climates around the world are intertwined. The depletion of water resources because of the decrease in the heat balance of the air here affects the regimen of water sources. Water potential decreases with excessive evaporation at high temperatures, water supplies may decrease, and drought may occur. With this decrease, the rates of fresh water and saltwater in the world are also changing, and water resources are disappearing due to the imbalance of rain and snow falls. It causes a decrease in the diversity of plants and animals. Climate change remains the world's problem. Unfortunately, this will affect our future generations as well.*'

The second question about climate change causes was designed to get students thinking about the reasons for climate change. The answers are formulated as open-ended so that their statements do not affect those who answer the questions. The following excerpt contains an ordinary response to this question. Here, at the macro level, people are hypothesized as important reasons for climate change. However, this perspective is rarely expressed from a personal or individual standpoint. Several expressions here have been found as feedback of the conceptual element (Shepardson et al. 2012). '*Humans play the biggest role in climate change. Uncontrolled sprays, excessive nylon, exhaust use. These are all products consumed because of production. There's so much production that it is already overdue. Of course, no one's calming the return of that. Everyone's consumer oriented. Unfortunately, it covers the entire world. For example, the garbage that comes out from under the sea shows that not only the land, but our waters are in great danger.*'

Only fourteen of all answers have touched on what everyone can contribute to mitigating negative climate change. The other answers are about what people can do. Participants view society as responsible for negative climate change at the macro level and have been observed to neglect individual responsibility. The following

excerpt is an exclusion since the student listed the options that everyone should think when acting to protect the climate: *'First, it is necessary to inform the community about this issue through various activities. We should pay more attention to recycling. Attention should be given to the use of energy (water, electricity). Industrialization should take measures against pollution and destruction. We must prevent rapid and distorted urbanization. Improper land use should not be allowed. We should put limitations on the use of substances affecting the ozone layer. Using fossil fuels should be reduced.'*

Although such responses are rare, the analysis conducted by Shepardson et al. (2012) on the students' statements revealed a more nuanced way of understanding how individuals perceive their everyday life situations in the data. Students have highlighted energy from fossil fuels and ecosystem degradation, but they have also been observed to highlight other aspects. Students shared their opinions on climate change through systemic thinking that included a variety of constituents: *'Environmentalists should be preferred in fuels used by industrial plants and vehicles. Electric modelers should be selected in cars. Otherwise, it is causing global warming. In this case, seasonal temperatures remain above normal, the waters evaporate, and water consumption increases. Thus, water supplies are reduced and the water level in our dams decreases.'*

Upon examining word frequencies, it was observed that the word 'earth' was frequently used in all three questions. This word was used with a rate of 31% in Table 1, with a rate of 37% in Table 2, and the highest rate was used with a rate of 77% in Table 3. When we look at the themes here, the word 'world' also appears in the themes. It can be said here that students think that this word is most related to climate change. Based on this, it can be said that our qualitative and quantitative findings are consistent with each other. In addition, the word 'human' appears as a highly used word in the first and third tables. Here, it can be thought that the students have stated that they have a significant impact on humanity in terms of climate change or sustainability. In Table 3, where the total responses are examined, it is observed that the word 'greenhouse effect' is perceived by the students as an important component in climate change with a rate of 65%.

Results, Discussion And Suggestions

As a result of our study, when the answers given by the students and the main themes in the answers were revealed, three main categories regarding the causes of climate change emerged. These are as follows:

- Living things
- World
- Atmosphere

The noteworthy findings garnered from this study necessitate responsible action on the part of all members of society to mitigate the deleterious consequences of climate change. The findings of our study showed that participants had various basic knowledge about climate change, such as the differences between weather events and climate change. Participants also emphasized social factors among the causes of climate change. This finding is similar to the findings of Ratinen (2021) and Özdem et al. (2014) in another study on this subject, it was observed that students emphasized social issues related to the causes of climate change. This supports the result of our study.

Prokopy et al. (2015) and Plutzer et al. (2016) stated in their study that teachers lack knowledge on basic issues related to climate change, such as the factors affecting the climate and how to slow down climate change. Another study found that there is a poor understanding of how to prevent climate change among teachers who have difficulty determining what affects climate change, and teachers do not have the necessary skills to teach their students how to develop a healthy world. Papadimitrou (2004) obtained findings in his research that are compatible with the findings of this study. Bozdin et al. (2014) conducted research pertaining to the comprehension of climate change among secondary school students. The study discerned that the participants exhibited an understanding of the distinction between fluctuations in weather conditions and the phenomenon of climate change, and they articulated global warming as a contributing factor to climate change (Bozdin et al. 2014). Leiserovitz et al. (2011) and Lombardi and Sinatra's (2012) study conducted with high school and higher education students found that the participants had a general lack of knowledge about climate change. This result differs from our study result. Because it was concluded that the participants of our study could evaluate the historical repetition or speed of climate change and express different levels of knowledge about climate change, that is, they had knowledge on the subject. The findings of Lombardi and Sinatra (2012) are similar to the findings of Olander and Olander (2017).

The investigation yielded the conclusion that the diversity and quantity of terminology employed by participants in a separate study to convey the concept of climate change serve as indicators of their vested interest in and familiarity with this subject matter. In their study with secondary school students, Olander and Olander (2017) asked the students two questions. According to the findings of the research, students used an average of 85.81 words in the first question and 93.01 words in the second question. From this perspective, it was determined that the findings of this study (S1, E: 89.53 and S2, E: 92.21) were similar to the findings of Olander and Olander (2017).

In our study, the answers given to the question "What affects the climate" showed that a social or general perspective emerged. The ability to relate social or general problems to personal problems can enable students to take more individual responsibility for climate change. The results of this investigation demonstrate an elevation in students' levels of knowledge. Similar findings were also obtained by Bozdin et al. (2014) in their research, as reported by Özdem et al. (2014) and Shepardson et al. (2012). However, it is necessary to investigate and determine which factors are effective in the formation of students' beliefs and attitudes regarding climate change and ecological balance. This aspect can be clarified by researching this issue in the future

In addition to all these, sustainability should be taken into consideration when providing climate change training. In particular, these trainings will be significantly effective in growing sustainable societies. Climate change education is very important for sustainable development. When elucidating the subject of climate change to students or instilling these concepts in them, it is imperative to incorporate notions associated with sustainability. The inclusion of these concepts not only enhances the comprehension of sustainable development but also underscores its significance. As sustainability becomes more prevalent in people's minds, awareness of climate change will increase significantly. Here, it is expected that the student's skills regarding sustainable development and climate change will increase. This expectation will enable them to establish a connection between the concepts of sustainability and climate change (Barak and Gönençgil, 2020).

Considering all these, it has emerged that students need to be informed more about climate change. Our study contributed to revealing this situation. Given the persistent escalation in discourse surrounding this matter in contemporary society and in successive generations, it ensues that this issue assumes paramount importance, necessitating a thorough and comprehensive elucidation to students. It should be emphasized that the problem is not just about weather events, but also that many facts and events related to human life are due to climate change. More research should be done on the subject. It is recommended to explain the subject more to students and to carry out different studies on climate change, especially using artificial intelligence tools.

Ethic

It should be stated which ethics committee approval was obtained from the research data. (25.03.2021, 1-57, Kastamonu University)

Author Contributions

All processes of the article (Introduction, Method, Results and Conclusion) were carried out by the author.

Conflict of Interest

The author declare that they have no conflict of interest.

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Differentiation of Self Predicts Counselor Burnout Through Effective Psychological Counselor Characteristics

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Abstract

Understanding effective psychological counselor characteristics and counselor burnout necessitates consideration of the family of origin as a pertinent factor. Differentiation of self may be one of the factors associated with these characteristics and counselor burnout. Psychological counselors with lower differentiation of self may fail to maintain emotional boundaries in a therapeutic process, resulting in counselor burnout. The present cross-sectional study undertook an examination of the mediating role played by effective psychological counselor characteristics within the context of the association between differentiation of self and counselor burnout. The sample comprised 240 Turkish psychological counselors actively engaged in psychological counseling practices, working mainly in schools. Participants responded to items in a survey including Differentiation of Self Inventory Short Form (DSI-SF), Effective Counselor Characteristics Scale (ECCS), Counselor Burnout Inventory (CBI), and a Demographic Information Form. Findings showed that differentiation of self has a direct effect on counselor burnout (Hypothesis 1), and effective psychological counselor characteristics mediated the association between differentiation of self and counselor burnout (Hypothesis 2). The path of differentiation of self to effective psychological counselor characteristics to counselor burnout explained 48% of the variance. The ongoing investigation has revealed the potential threats linked to reduced self-differentiation concerning effective psychological counselor characteristics and the phenomenon of counselor burnout.

Key Words

Differentiation of self • Effective psychological counselor characteristics • Psychological counselor burnout

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Introduction

Increasingly adverse life events, including traumas and crises, have drawn attention to how individuals recover from such experiences. Mental health professionals assist their clients with that purpose in a therapeutic recovery process, but how they manage the secondary effects of these adverse on them doesn't pique much of researchers' interest. One of the risks for mental health specialists is burnout because prolonged exposure to trauma-related anxious feelings or stress experienced by clients may lead to emotionally dysfunctional responses for therapists (Craig & Sprang, 2010). Three elements of burnout indicate a cluster of work-related psychological dysfunction that typically affects individuals with no history of mental or psychological diseases (Maslach et al., 2001; Maslach & Leiter, 2016): (a) *Emotional exhaustion* may also be characterized by fatigue, referring to losing the sense of emotional energy or emotional deprivation to one's bodily and emotional capacities being exhausted. (b) *Cynicism* is the loss of enthusiasm, and idealistic thinking, developing a negative mindset toward clients, and emotionally distancing from others that depersonalize human services. (c) *Inefficacy* refers to employees' self-evaluations, indicating a lower sense of productivity, capability, or achievement relative to the job requirements. Psychological counseling is one of the professions that received researchers' (Lee et al. 2010) attention regarding burnout, especially when they lose the balance between clients' needs, their own needs, and stress-producing circumstances in their job (Maslach, 2017), which may affect the well-being and professional efficiency of counselors.

Counselor Burnout

Similar to Maslach's (2001) burnout configuration, Lee et al. (2007) suggested five dimensions of burnout for psychological counselors also provide a theoretical basis for the study: (a) *Exhaustion* refers to the extent to which a counselor becomes tired or distressed physically and emotionally due to the responsibilities of being a counselor. (b) *A negative work environment* is indicative of a scenario wherein the workplace or work-related circumstances assume the role of originating factors associated with feelings of frustration, perceived unfairness, and heightened levels of exhaustion, extending beyond considerations of personal or interpersonal factors. (c) *Devaluing client* reflects Maslach's Depersonalization dimension that counselors become more unemphatic or insensitive to clients' needs. (d) *Incompetence* refers to a counselor's feelings of non-confidence or inadequacy to assist clients. (e) *Deterioration of personal life* reflects the limited space for a counselor to spend more time on personal interests, relationships with significant others, or self-development. Later, Lee et al. (2010) filtrated these five dimensions into another configuration of burnout for psychological counselors with three dimensions: (1) *Well-adjusted counselors* have high-functioning characteristics as they have lower scores in all five dimensions of counselor burnout. (2) *Disconnected counselors* score medium to high in five counselor burnout dimensions. However, this profile matches more with Depersonalization Clients (DC); counselors with this profile have the lowest job satisfaction and worst self-esteem compared to other burnout profiles. (3) Although they have higher scores on exhaustion in their workplace or personal life, *persevering counselors* are psychologically more flexible and sensitive to the needs that clients bring to the therapeutic process. Counselors exhibiting this particular profile demonstrate elevated levels of self-esteem and possess a greater breadth of professional experience, despite concurrently reporting a notable degree of job dissatisfaction. (Lee et al., 2010).

Literature indicates several factors relating to burnout in mental health workers. The work environment is one of the organizational factors for counselor burnout. For instance, psychological counselors who work with offenders or work in prisons as correctional counselors (professional counselors working in prisons) reported higher burnout levels (Carrola et al., 2016; Lee et al., 2010). Individual factors may also play a role in counselor burnout. For instance, Lee et al. (2011) emphasized the risks of overinvolvement, which may cause burnout while improving a therapist's sense of self-accomplishment. Psychological counselors become excessively involved in their clients' psychological care because they may have a secondary gain of accomplishment that rewards over-involved actions, which may result in emotional exhaustion with the therapeutic process. Fye et al. (2020) also asserted that *Impotence* is another individual factor in understanding counselor burnout. School counselors may handle this sense by using avoidant-emotional coping strategies, resulting in the *Devaluing Clients* dimension of burnout. On the other hand, role ambiguity, role incongruity, and job dissatisfaction are organizational factors that predict counselor burnout (Fye et al., 2020). Likewise, role conflict and ambiguity have been identified as risk factors associated with counselor burnout within the context of Türkiye, as evidenced by Özer (1998). The vast majority of Turkish psychological counselors work in schools (Korkut, 2007). For instance, Turkish psychological counselors' dysfunctional self-efficacy beliefs (as an individual factor) in assisting their students may relate to counselor burnout levels (Öztabak, 2018). Conversely, potential remedies for mitigating counselor burnout may come to fruition if school counselors are not assigned non-counseling responsibilities within their educational institutions, receive comprehensive supervision pertaining to their occupational growth, and acquire more efficacious and task-oriented stress management skills, as posited by Kim and Lambie (2018).

We suppose that family of origin may also be a potential predictor in understanding counselor burnout and effective counselor characteristics. Intimacy is one of the most paradoxical concepts in human relationships, reflecting several intrinsic requirements and challenges, such as separateness vs. closeness (Williamson, 1991). Bowen's Family Systems Theory (BFST; Bowen, 1978) uses the psychological construct of differentiation of self (DoS) to address this dilemma in family dynamics. The elevated level of DoS effectively upholds the inherent requisites of both autonomy and intimacy in equilibrium; nevertheless, it is noteworthy that this predicament transcends the confines of the family milieu and extends to other spheres of human interaction. We suppose that a therapeutic relationship may also require such an equilibrium between counselor and client that over-involvement, emotional exhaustion or depersonalization emerge otherwise.

Differentiation of Self

The fundamental component of BFST is DoS, which calls for two key competencies (Bowen, 1978; Kerr & Bowen, 1988): (1) For more effective DoS, one recognizes a distinction between cognitive processes and emotional responses to stressful circumstances. Through the application of this approach, individuals can effectively respond to challenges within their proximate relationships in a rational manner, circumventing automatic emotional reactions. This capacity is particularly advantageous in the context of stressful and anxiety-inducing situations. Moreover, individuals often encounter heightened difficulty in regulating their emotions and cognitive processes when confronted with adverse circumstances, as is elucidated within the intrapsychic dimension. Additionally, another

salient dimension encompasses the ability to concurrently attain individuation while preserving authentic and close interpersonal connections with significant others in one's social milieu, constituting the interpersonal dimension. In the lack of higher DoS, emotional symptoms may develop within the family system, such as triangling (Kerr & Bowen, 1988). A triangle represents the smallest emotional unit of a trio among family members. Although children are involved in triangles as they are the least-differentiated family members, the third part may be an outside individual such as a friend or therapist (Bowen, 1978). The role of the third person in a trio might be to reduce the chronic anxiety in a dyad's conflict or family crises (Kerr & Bowen, 1988). Bell et al. (2001) classified triangles into distinct dimensions: *Mediator* reflects the third person's pull-in position as a peacemaker between two members of the triangle by alleviating both sides and forming more intimate bonds with either part of the triangle than they do with one another. *Scapegoating* reflects the third person's pull-out position as other parts of the triangle become more preoccupied with the scapegoated individual's actions than their dyadic relationship. *Coalitions* reflect the side-taking position of the third person in a triangle. Within familial dynamics, it is not uncommon to observe the formation of emotional alliances between a parent and one of their children, often uniting against the third member of the family unit. An illustrative example would involve the alignment of the mother and a child in opposition to the father. In a related context, the term *balanced* signifies a state characterized by equitably distanced emotional boundaries maintained among all members comprising a triangular relational configuration. Members of a triangle can manage their conflicts constructively and psychological distress in their dyadic relationship.

The point is that individuals with lower DoS are more prone to be involved in triangles (Kerr & Bowen, 1988). Integrating Bell et al. (2001) configuration into a therapeutic process, for instance, a family counselor with lower DoS may unconsciously attempt to reduce the dyadic tension by positioning in the mediator role as the counselor internalizes this calming role in the family of origin triangles. Furthermore, it is noteworthy that family counselors may inadvertently become participants in the process of aligning with one side or another within the familial context, thus inadvertently contributing to side-taking dynamics. The counselor may take sides with one spouse that the counselor perceives is more aggrieved in the relationship, ignoring that both parties may somehow contribute to the development of the relationship problem. Over-involvement or emotional contagion (Hatfield et al., 1993) may blur the boundaries between therapist and clients in a therapeutic relationship. Bowen (1978) defined such blurred boundaries among family members as *fusion*. When the fusion is the case, counselors may suffer in a therapeutic context to manage their emotional reactions to the clients and avoid imposing their values onto their clients as opposed to ACA's (2014) ethical rules. The capacity to maintain the balance between closeness and separateness is related to the therapist's DoS level (Bowen, 1978). Some counselors may be more prone to burnout than others, which may be explained by how they manage their emotions in the context of a disequilibrium of closeness and separateness. On the other hand, we suppose that psychological counselors with higher DoS may more likely have several effective counselor characteristics that protect them against burnout.

Effective Psychological Counselor Characteristics

What kind of personal and professional characteristics a psychological counselor should have has been a long-standing topic. One point of this discussion, for example, is based on the observations of those who take part in the training of prospective psychological counselors because while some trainees adapt to this new role quickly, some trainees have difficulty in fulfilling what is expected of them and adapting to the characteristics of a psychological counselor (Rowe et al., 1975). The experts in psychological counseling are beginning to acknowledge the need to consider personal characteristics when selecting and retaining students in their training programs; however, there is less consensus on these characteristics (Pope & Kline, 1999). Some experts in psychological counseling listed the most remarkable personal characteristics of effective psychological counselors, such as (1) unconditional acceptance of clients, (2) being emotionally stable, (3) skill of empathy, (4) being open-minded, (5) being genuine, (6) being flexible, (7) having an interest in others, (8) having self-confidence, (9) being sensitive to client's needs, and (10) fairness (Pope & Kline, 1999). İkiz and Totan (2014) illustrated six dimensions in the assessment of effective psychological counselor characteristics in a Turkish sample: (a) *Intellectual competence* refers to a counselor's cognitive skills to contribute to the client's well-being, besides a curiosity to develop these skills when necessary in conceptualization, decision-making, or interviewing processes. (2) *Energy* refers to a psychological counselor's physical and emotional dynamism that can give clients the confidence they need and make them feel that they are in safe hands in a therapeutic process. (3) *Flexibility* refers to the ability of a psychological counselor to adapt necessary methods, theoretical approaches, and technological requirements into the process depending on the client's therapeutical needs. (4) *Support* reflects that a psychological counselor maintains the balance that clients can have the responsibilities of their own choices without being dependent on the psychological counselor. However, the therapeutic process with support should still include hope and emotional safety. (5) *Goodwill* constitutes an essential responsibility of psychological counselors, entailing the conscientious avoidance of prioritizing their own emotional requisites over the therapeutic needs of their clients, while concurrently upholding ethical standards and a sense of accountability. (6) *Self-awareness* reflects that psychological counselors recognize their personal strengths and limitations besides the psychological and technical needs within a therapeutic process. Thus, the psychological counselor manages the most appropriate psychological roadmap to structure and maintain the counseling relationship.

The research revealed that effective psychological counselor characteristics may also impact career-related processes. For instance, Turkish psychological counselors with effective psychological counselor characteristics and subjective well-being reported higher career adaptability (Özbiler et al., 2022). Nevertheless, there exist certain impediments that psychological counselors may encounter in their endeavors to embody and exhibit these efficacious characteristics. For instance, Baştemur and Uçar (2022) defined these obstacles congruently with İkiz and Totan's characteristics. In their data, self-awareness, good intentions, and flexibility were predominant predictors of effective psychological counselor characteristics in the empowerment needs of Turkish school counselors. Additionally, it is worth noting that a subset of Turkish school counselors has reported deficiencies in both knowledge and skill, indicative of a deficit within the *Intellectual Competence* dimension. Concurrently, these counselors have also indicated a lower level of self-awareness in the context of their counseling practices.

Rationale of the Current Study

Research that focuses on the family-of-origin experiences of psychological counselors and their effective counselor characteristics and burnout is scarce. Softas-Nall et al. (2001) reported that family of origin, which indicates the family health level of participants and some aspects of personality traits (e.g., social introversion), contributed to the prediction of counselor trainees' effectiveness. In a parallel vein, Alber (1991) has asserted that DoS plays a significant role in shaping the skill set of counselor trainees concerning their positions within the familial structure of their origin. The trainee would be a triangulated child in the family of origin to reduce the dyadic anxiety. Because of the anxiety-reducing role in the family of origin and inflexibility against compelling emotions such as anxiety, the trainee would not prefer to mention an anxiety-related issue of the client in a therapeutic process as an indicator of lower DoS. DoS is a skill that individuals develop in their family of origin. An individual born in a dysfunctional family dynamic will likely have a low level of DoS and difficulty balancing between closeness and separateness, especially when various sources of stress emerge in their social and close relationships (Bowen, 1978). For example, individuals of this nature may encounter challenges in effectively managing and coping with complex emotions, including but not limited to feelings of anxiety, antipathy, and remorse, experienced within the context of their partner's emotional landscape. Such emotional turmoil may be exacerbated in the presence of conflicts, thereby rendering them ill-equipped to navigate and effectively manage these tumultuous periods within their romantic relationships. They may prefer dysfunctional ways to deal with these feelings, such as emotional cutoff (Kerr & Bowen, 1998), which will likely cause them to feel more exhausted in the relationship. Similarly, the therapy setting has a context in which clients experience such emotions. While working with these emotions, psychological counselors with greater DoS, on the other hand, can differentiate their emotions from thoughts (intrapsychic dimension) and maintain therapeutic boundaries with the client (interpersonal dimension) against emotional exhaustion. Hence, we posit that the theoretical underpinnings of the present model hold the potential to make a valuable scholarly contribution to the existing literature by enhancing our comprehension of the significance of family of origin dynamics in influencing the effectiveness of psychological counselors. Moreover, to date, no research has ever investigated the mediating role of effective psychological counselor characteristics in the associations between family-of-origin (i.e., differentiation of self) and counselor burnout. Our study formulated two hypotheses:

* H_1 (DoS to counselor burnout): Psychological counselors with higher DoS will report lower counselor burnout.

* H_2 (DoS to effective psychological counselor characteristics to counselor burnout): Psychological counselors with higher DoS will report higher effective psychological counselor characteristics and lower counselor burnout.

Method

Participants and Sampling

In total, 240 psychological counselors (169 female, 70.4%; 71 male, 29.6%) participated in the study from different regions of Türkiye. We applied a purposive sampling strategy in data gathering. The participation criteria were being actively engaged in psychological counseling practices. The mean age for our study was 33.53 years (*SD*

= 7.59), ranging between 25-41 years (75%). Only ten participants (4.2%) had not graduated from the Department of Psychological Counseling and Guidance. Among the cohort of 162 participants, a majority, comprising 67.5%, possess bachelor's degrees, while 78 (32.5%) individuals among the surveyed psychological counselors have completed advanced degrees, namely master of science and doctoral qualifications. In total, 176 participants reported that they evaluate themselves as an effective psychological counselor (73.3%), and 64 participants have not stable opinions on their competence (26.7%). The mean for the years of experience in psychological counseling was 10.31 (*SD*=7.71), ranging between 1 and 31 years. 71 (29.6%) participants were working as a school counselor in secondary schools, 69 (28.8%) were in high schools, 47 (19.6%) were in primary schools, 13 (5.4%) were in kindergarten, 18 (7.5%) were in Guidance and Research Centers, and 22 (9.1%) were others such as private practice in psychological counseling.

Procedure

We collected the data through an online survey method, and the first page of Google Forms contained a consent form for participants to declare their voluntariness to participate in the current study. The link for the survey has been delivered to several WhatsApp groups of psychological counselors along with the purpose of the study. These WhatsApp groups were created by psychological counselors (e.g., school counselors) in different cities to maintain academic coordination or information-sharing. The researchers established communication with psychological counselors situated in diverse geographic locations via telephone calls and electronic correspondence, specifically email and WhatsApp. Subsequently, they requested these counselors to disseminate the online survey link within their respective professional networks.

Research Instruments

Differentiation of Self Inventory Short Form (DSI-SF). The scale was developed (Drake et al., 2015) to evaluate the DoS and contains 20 items (with a 6-point Likert type, 1; not at all true of me to 6; very true of me). Cronbach's Alpha coefficients (for the dimensions and total score) are between .68 and .88, and test-retest reliability is .72 to .85 (Drake et al., 2015). The minimum and maximum scores differ from 5 to 30 on mean values in total score. Higher scores indicate higher DoS. Turkish DSI-SF (Sarıkaya et al., 2018) revealed .61 to .82 Cronbach's Alpha and .70 to .86 test-retest reliability coefficients. Cronbach's alpha and McDonald's Omega coefficients of the DSI-SF were between .88 in the current study. An item example is "Even under pressure I try to stay fairly calm."

Effective Counselor Characteristics Scale (ECCS). The scale was developed (İkiz & Totan, 2014) to evaluate the several effective psychological counselor characteristics (i.e., self-awareness, energy, support flexibility, goodwill, and intellectual competency), contains 26 items (with a 5-point Likert type, 1; not at all true of me to 5; very true of me). Cronbach's Alpha coefficients (for the dimensions and total score) are between .63 and .90, and test-retest reliability .67 to .78 (İkiz & Totan, 2014). The minimum and maximum scores vary from 26 to 130 in total scores. Higher scores indicate higher effective counselor characteristics. Cronbach's alpha and McDonald's Omega coefficients of the ECCS's total score were .92 in the current study. An item example was "I love being a psychological counselor."

Counselor Burnout Inventory (CBI). The scale was originally developed (Lee et al., 2007) to evaluate the burnout levels of American psychological counselors and contains 19 items (with a 5-point Likert type, 1; never true to 5; always true). Cronbach's Alpha coefficients (for the dimensions and total score) were between .68 and .88, and test-retest reliability of .73 to .85 (Lee et al., 2007). The range of scores observed in the assessment spans from a minimum of 19 to a maximum of 95. It is important to note that higher total scores on this assessment are indicative of elevated levels of burnout. Turkish CBI (Guler & Turkum, 2019) revealed .61 to .82 Cronbach's Alpha and .71 to .89 test-retest reliability coefficients. Cronbach's alpha coefficient of the CBI's total score was .90. McDonald's Omega coefficient was .91 in the current study. The item example is "I have very little empathy with my clients."

Demographic Information Form. We developed a study-oriented form to evaluate the demographic characteristics, including gender, age, service years, and education levels of the participants.

Data Analysis

We conducted preliminary analyses, including descriptives, bivariate analyses, and assumption testing through SPSS 22 (IBM, 2013). We implemented the bootstrapping technique for the mediation analyses to adjust the inflated chi-square statistic (Nevitt & Hancock, 1998) within the Maximum Likelihood Estimation (MLE in AMOS 24; Arbuckle, 2016). We considered the fit indices of $\chi2/df$-ratio < 5 (Kline, 1998), CFI and TLI $\geq$ .93 (Byrne, 1994), Mediocre fit: .08 < RMSEA < .10 (MacCallum et al., 1996), and SRMR < .08 (Browne & Cudeck, 1993). Because the scales in our model consist of many items to a single latent variable (i.e., 20 items for DoS, 26 items for ECCS, 19 items for CBI), we applied item parcels to adjust structural bias in parameters and measurement errors (Bandalos, 2002). Thus, four parcels for each variable in the structural model were produced, and individual items of the scales were appointed to these parcels through random assignment, for which we considered items' mean values from highest to lowest (Little et al., 2002).

Results

Data Preparation, Descriptive Statistics and Bivariate Correlations

The data had no missing values as all item's response was mandatory in the online survey form. The data was free from outliers, skewness (highest, 1.79), and kurtosis (highest, 2.84) values were within required limits (Kline, 2011) except five items (in ECSS and CBI) which were slightly exceeded (highest was 3.77) the limits. These particular items were identified as potentially susceptible to outliers, primarily owing to their content, which involves the evaluation of exceptional circumstances not commonly encountered by the majority of psychological counselors. As an illustrative example, one of these items examines the extent of empathy or lack thereof exhibited by counselors toward their clients, a dimension that typically aligns with the fundamental competencies of the counseling profession.The bivariate Pearson correlations were not higher than the cut-off value of .90 (Kline 2011) among study variables which the strongest correlation among study variables was between DoS and burnout (r=-.61, p<.001). The tolerance values for each variable were well above .20 (minimum tolerance = .38), and we have no observed violation of linearity and homoscedasticity by examining the scatter and regression plots. The sample revealed a higher level of DoS ($M = 83.32$, $SD = 13.89$), effective counselor characteristics ($M = 104.28$, $SD = 10.96$), and

lower burnout ($M = 36.76$, $SD = 11.65$) compared to possible range scores, as shown in Table 1. Further, we also compared participant groups of those who reported themselves as having effective psychological characteristics and those who did not (i.e., 'I am not an efficient psychological counselor,' 'I have to do more' or 'I have no conclusion') through an independent sample t-test. The results indicated that participants who reported themselves as having effective psychological characteristics had higher levels of DoS [t (238) = 4.398, $p<.001$], and lower levels of burnout [t (238) = -5.424, $p<.001$].

Table 1

Descriptives, Bivariate Correlations, and Reliabilities of the Study Variables (N=240)

	1. Differentiation of Self	2. Effective Counseling	3. Burnout
1.	-		
2.	.35**	-	
3.	-.61**	-.38**	-
M	83.32	104.28	36.76
SD	13.89	10.96	11.65
Range	48-119	53-129	19-70

Note. ** $p<0.001$ (two-tailed).

Measurement invariance

We examined the measurement invariance of the structural model on gender differences through JASP Team (2019) using four phases of configural, metric, scalar, and strict invariance (Milfont & Fischer, 2010). We considered fit indices of ΔCFI, ΔRMSEA, and ΔTLI which the changes should be between -0.01 and 0.01 (Cheung & Rensvold, 2002). The results indicated that the highest changes in the four phases considering gender were 0.006 for CFI, 0.005 for RMSEA, and 0.007 for TLI, and we concluded that the model met the measurement invariance on gender.

Mediation Model

The model (see Fig. 1) examined the relationships between DoS and burnout through the effective psychological counselor characteristics. The findings indicated a moderate model fit of $\chi2$ (51)=152.43, $p<.001$; $\chi2$/df-ratio=2.99, CFI=.95, NNFI=.94, SRMR=.04, RMSEA=.091(90% CI=.075-.108). Factor loadings were significantly between .67 and .91. DoS accounted for 14% of the variation in effective psychological counselor characteristics. DoS and effective psychological counselor characteristics accounted for 48% of the variation in psychological counselor burnout. The direct effect of DoS on psychological counselor burnout (β =-.57, $p<.001$) was significant.
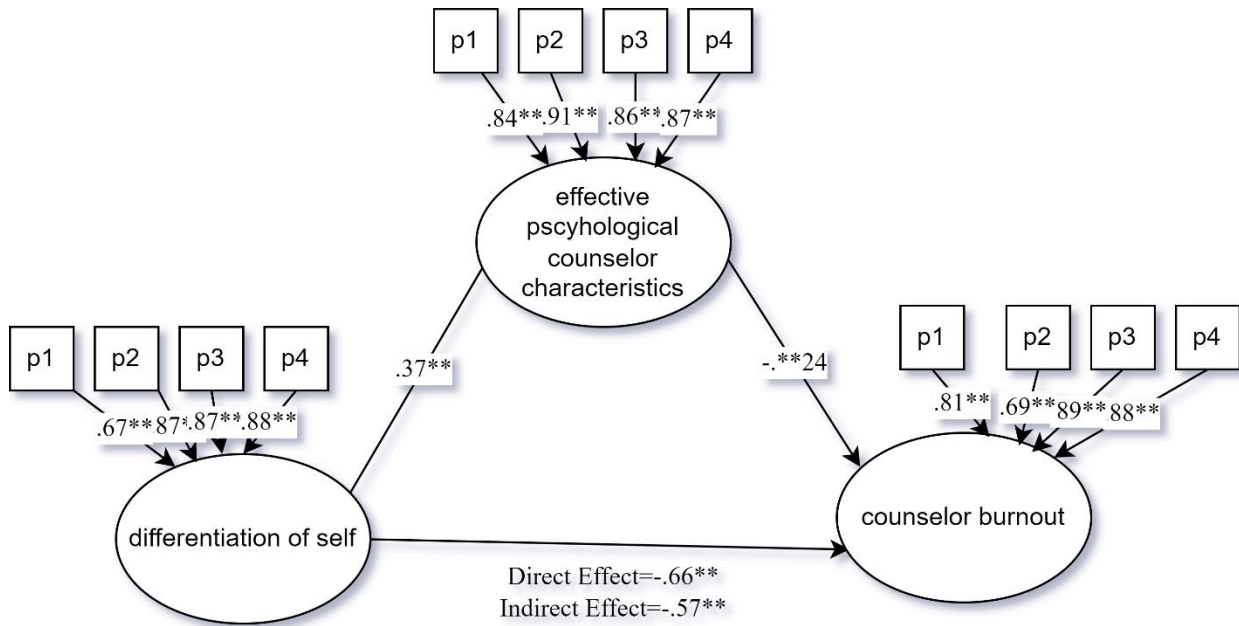
Figure 1. Standardized coeefficients and paths (** *p*<.001)

H₁ (DoS to psychological counselor burnout). The direct effect of DoS on psychological counselor burnout (*β* = -.57, *p*<.001) was significant in the mediation model. An observable trend emerges wherein psychological counselors with a heightened degree of DoS tend to manifest lower reported levels of burnout.

H₂ (DoS to effective psychological counselor characteristics to psychological counselor burnout). The indirect effect of DoS on psychological counselor burnout through effective psychological counselor characteristics (*β*=-.11, *p*<.010, [CI=.05, -.17]) was significant. Psychological counselors exhibiting a higher degree of DoS tend to report elevated levels of effective psychological counselor characteristics and concurrently exhibit reduced instances of psychological counselor burnout.

Discussion

First Hypothesis

The first hypothesis investigated if DoS directly affects psychological counselor burnout, and the findings indicated a statistically significant direct relationship. More specifically, psychological counselors with greater DoS reported lower psychological counselor burnout. This significant direct effect contributes to the limited literature regarding the association between DoS and psychological counselor burnout. Researchers found an inverse relationship between DoS and psychological counselor burnout and concluded that DoS should be considered for psychological counselors' burnout levels (Duggan-Waters, 2021; Wallace, 2023) with US samples. Moreover, similar findings (Guarino & Borja, 2019) were reported that DoS dimensions negatively predicted psychological counselor burnout within a Philipino sample. Furthermore, the current findings have also supported an inverse relationship between DoS and psychological counselor burnout within a Turkish culture that has both elements of individualistic and collectivistic elements (İmamoğlu, 1998; Kağıtçıbaşı, 2007).

Second Hypothesis

When effective characteristics were included in the model, the second hypothesis theoretically consolidated the association between DoS and psychological counselor burnout. When psychological counselors reported greater DoS, they reported higher effective counseling characteristics, resulting in lower burnout. ECCS (İkiz & Totan, 2014) has six dimensions for predicting what characteristics define a psychological counselor as efficient: (1) intellectual competence, (2) energy, (3) flexibility, (4) being supportive to clients, (5) goodwill for clients, and (6) self-awareness. Although we found no study (to our knowledge) that examines the relationships between these components and DoS directly, limited studies investigated some of the psychological counselors' or trainees' characteristics. Empirical evidence suggests that psychological counselors characterized by a lower degree of DoS tend to exhibit a greater propensity for engaging in countertransference behaviors, as well as experiencing heightened levels of overinvolvement or underinvolvement emotions, as indicated by studies (Connery, 2012; Connery & Murdock, 2019). Wozny et al. (2015) emphasized the role of greater DoS in the decision-making abilities of psychological counselor trainees in ethical dilemmas. Sanderlin (2020) reported the role of DoS in managing client stress and interpersonal conflict in association with trainee self-efficacy. Trainees with greater DoS and emotional health had lower distress in their development. Seay (2015) also shows the relationship between DoS and the trainees' self-efficacy. Psychological counselors with greater DoS may be more flexible when they discuss uncomfortable issues such as clients' sexual concerns or behaviors (Heiden-Rootes et al., 2017). One can speculate that greater DoS may provide many advantages for psychological counselors or trainees in their therapeutic skills to have effective counselor characteristics. The current study contributed to research indicating the relationship between DoS and effective psychological counselor characteristics. Moreover, the model extended the understanding of the consequences (i.e., burnout) when psychological counselors have poor DoS and ineffective skills in a therapeutic process.

Implication for Theory and Research

In accordance with Bowen's Family Systems Theory (BFST; 1978), it is suggested that the psychological counselor's fundamental perspective concerning emotional matters, such as anxiety, as well as their ability to establish and maintain boundaries conducive to intimacy within the therapeutic alliance, may be intricately linked to the counselor's level of DoS. Our results offer empirical support for an association between DoS, having effective counselor characteristics, and patterns of interpersonal relating resulting in burnout. Our findings may suggest that psychological counselors' effective characteristics may be linked to their DoS levels in their relationships with significant others; however, it is incumbent upon these practitioners to assimilate these acquired skills into the fabric of therapeutic relationships they establish with their clients. Although further research is required, attempts in the professional development of psychological counselors and prospective psychological counselors should address that linkage from a theoretical perspective. Moreover, the results are valuable because they indicate how Turkish psychological counselors may develop more effective counselor characteristics against burnout when they have a greater DoS. We suggest for further research including new variables in integrative theoretical models comparable to the model we outlined in the current study, such as resilience may have a tandem with DoS in understanding

psychological counselors' effectiveness as both constructs may emphasize healthy coping mechanisms with anxiety-provoking circumstances in a therapeutic process.

Implication for Practice

One can define a great list of characteristics a psychological counselor should have when working with clients. One of these characteristics that could be at the top of the list is to avoid countertransference as it affects the efficiency of a therapeutic process (Gelso et al., 2002). Psychological counselors and therapists should be careful with their reactions to their clients in a therapeutic context. Researchers preferred to expand the definition of countertransference, which may cover all the emotional responses of a psychological counselor to the client's issues as countertransference (Hayes et al. 1997). Several client characteristics, behaviors, attitudes, problems, or circumstances may cause the counselor's emotional reactivity (Tobin & McCurdy, 2006). Emotional reactivity is one of the sub-dimensions of DoS's assessment (Skowron & Friedlander, 1998), referring to the poor functioning of an individual (Kerr & Bowen, 1988). Although we did not examine the sub-dimensions of DoS in the model separately, a psychological counselor with lower DoS may have poor functioning in their emotional reactions to the client's issues in the therapeutic process. For this reason, we suggest supervision services be included in the in-service training or curricula for the prospective psychological counselors, besides the currently working counselors, to improve DoS-related skills. Psychological counselors may benefit by considering their dysfunctional emotional management patterns relating to lower DoS in a therapeutic context and how this dysfunction may be causing burnout at work.

Limitations

We define several limitations in the current study. (1) We had a sample imbalance in the current study, in which our participants were mainly female psychological counselors (70.4%). We suggest that future studies be demographically more gender-balanced to improve their representativeness. (2) Although the instruments we used in the current study are psychometrically valid and reliable, they are self-report measures that depend on a psychological counselor's self-awareness of the study variables. (3) The current study has a correlational design nature, in which we can not conclude DoS causes more effective psychological counselor characteristics and counselor burnout, indicating the lack of cause and effect in the relationships. Thus, we suggest a longitudinal design for future research. For instance, prospective psychological counselors' DoS levels may be observed during undergraduate or graduate while they have supervision. (4) Our participants were mainly school psychological counselors, which may limit our conclusions to be generalized to other psychological counselor groups (e.g., private practice).

Ethic

Ethical permission was granted from the institutional review board of Ordu University Social and Human Sciences Ethics Committee (approval number: 2022-150).

"We declare that the research was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical

standards. Informed consent was obtained from all individual participants included in the study. The research at hand is devoid of any discernible conflict of interest. The study approved by Social and Humanities Research and Publication Ethics Committee of Ordu University. The authors received no financial support for the authorship, research, and/or publication of this article."

Author Contributions

The authors contributed at all stages, including planning, conducting and writing.

Conflict of Interest

There is no conflict of interest in this study.

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A Systematic Review of Digital Mathematics Game Articles Published in Peer-Reviewed Journals in Türkiye From 2005 to 2023

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Abstract

The current study aimed to provide a detailed synthesis of the literature on digital mathematics games and to gain an in-depth understanding of the current status of research on digital mathematics games. For this purpose, digital mathematics game articles published in peer-reviewed journals from 2005 to 2023 were systematically reviewed. To locate these articles, the following keywords were searched in TR Index, DergiPark Academic, and Google Scholar: "digital game", "video game", "computer game", "interactive game", "mobile game", and "serious game". The articles retrieved from the search were subjected to a two-stage screening process. First, the titles and abstracts of the articles were examined. Second, their full texts were examined. After the screening process, 26 articles that suited the purpose of the study were determined. Relevant data from the selected articles were extracted manually, recorded in an Excel spreadsheet, and finally synthesized. The findings were reported using the following research trends: (*i*) research aims, (*ii*) research methodologies, (*iii*) research participants, (*iv*) sample sizes, (*v*) designers of the digital mathematics games, (*vi*) environments used for designing digital mathematics games, and (*vii*) learning domains of the digital mathematics game topics. The findings are discussed based on the literature and implications for stakeholders are presented.

Key Words

Digital mathematics games • Peer-reviewed journal articles • Systematic literature reviews

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Introduction

A game can be defined as "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (Salen & Zimmerman, 2004, p. 80). More specifically, digital games can be defined as games that are located on computers, mobile devices, game consoles (Becker, 2017; Jensen & Skot, 2022), and tablets (Jensen & Skot, 2022). Gredler (2004) argues that digital games are modernized versions of non-digital games that utilize advanced technology. However, although digital games share some similarities with non-digital games, they have evolved to become much more than their non-digital counterparts. For example, in digital games, the model of the original system must be meticulously and precisely defined, the rules must be fully decided in advance, the environment must be dynamic and the same for all players, and the interactions must remain consistent throughout all instances of the game, regardless of the location, time, or player (Becker, 2017).

Digital games can be categorized into two as educational games and commercial-off-the-shelf (COTS) games (Hu & Sperling, 2022). Educational games are games that are specifically designed to improve students' academic learning and boost their learning motivation (Mayer, 2014). The integration of educational games into instruction is a complex process that demands and necessitates substantial strategic preparation on the part of the instructor (Hu & Sperling, 2022). Moreover, educational games should be designed in accordance with the learning objectives of the school curricula (Ministry of National Education, [MoNE], 2023) or content or process standards (Council of Chief State School Officers, 2023). Therefore, instructors who want to use educational games in their classrooms must have sound specialized content knowledge (Hsu et al., 2013) and particular expertise in game-based teaching (Foster & Shah, 2020).

On the other hand, COTS games are created largely for enjoyment rather than academic instruction, they can be bought and used by the general public, but they are not specifically designed to meet the learning objectives or standards in school curricula (Ritzhaupt & Gunter, 2010). However, some COTS games include features from real-life environments and allow students to learn about the topics and skills traditionally taught in the classroom (Becker, 2017; Hu & Sperling, 2022). For instance, in middle school, Angry Birds can be employed to teach kinematics (Rodrigues & Carvalho, 2013). In high school, it can be employed to teach parabolas and vectors (Lamb, 2014). The SIMs and FIFA Soccer can be utilized for learning new languages (Purushotma, 2005; Wang, 2006). Furthermore, Assassin's Creed can be used for teaching the Renaissance period in history and social studies classrooms due to including correct historical information about this period (Starkey, 2015). Hence, COTS may be used in a variety of educational contexts as a complement to non-game teaching.

Digital games are new technologies that have advanced and interactive features and are continually designed, tried out, and advocated in educational environments (Hu & Sperling, 2022). They are sophisticated technologies that give players multifaceted experiences thanks to each game's distinct design and play mechanics (Ke, 2016). At the beginning of the twenty-first century, Prensky (2001) derived the phrase "digital game-based learning" (DGBL) based on the term "digital game". He broadly defined DGBL as any learning activity in which digital games are employed. However, Van Eck (2015) expanded on this definition and defined DGBL as "the use of games within an existing lesson, classroom, or other instructional contexts where the intent is at least as much to learn rather than to

(exclusively) have fun" (p. 144). In the current study, I prefer to use the term "digital mathematics game" to refer to the digital game used in the course of learning mathematics. After Prensky's (2001) invention of the phrase "DGBL", the interest in digital mathematics games has grown dramatically within the mathematics education research community (e.g., Byun & Joung, 2018; Jensen & Skott, 2022; Joung & Byun, 2021; Yeo et al., 2022). With this increasing interest, over the past two decades, mathematics education researchers have been trying to figure out the instructional advantages of digital mathematics games on students' different kinds of learning outcomes such as cognitive learning outcomes (knowledge and skills), motor skills (acquisition and compilation), affective learning outcomes (attitude and motivation), and communicative learning outcomes (Wouters et al, 2009).

However, as articulated by several researchers (e.g., Ke, 2009; Kim & Chang, 2010; Monaghan, 2016), the literature on the effectiveness of digital games on students' learning outcomes is disconnected, inconsistent, and not well-organized. Ke (2009) further claimed that research on digital games must "take a systematic, comprehensive approach to examine dynamics governing the relations among multiple influential variables in a game-based learning system" (p. 24). The fragmentation and incoherency in the educational literature about digital games also seem to be the case for the literature on digital games in mathematics education. For instance, some researchers found out that digital mathematics games significantly impact students' mathematics achievement or performance (e.g., Bai et al., 2012; Beserra et al., 2014; Ke & Grabowski, 2007; Kebritchi et al., 2010; Kolovu et al., 2013), while some other researchers reported that digital mathematics games have a non-significant impact on students' mathematics achievement or performance (e.g., Carr, 2012; Ke, 2008a, 2008b, 2008c). Furthermore, several meta-analysis studies stressed that there is limited empirical evidence to support the effectiveness of digital mathematics games on students' cognitive learning outcomes (e.g., Byun & Joung, 2018; Wouters et al., 2013; Young et al., 2012).

Meanwhile, several researchers revealed that digital mathematics games have a significant impact on students' motivation to learn mathematics (e.g., Bai et al., 2012; Habgood & Ainsworth, 2011; Ke, 2008a) and attitude towards mathematics (e.g., Garneli et al., 2017; Ke & Grabowski, 2007; Ke, 2008a, 2008b, 2008c, Mavridis et al., 2017). In contrast, in some other research studies, it was reported that digital mathematics games do not significantly affect students' motivation to learn mathematics (e.g., Kebritchi et al., 2010) and attitude towards mathematics (e.g., Lopez-Morteo & Lopez, 2007; Pareto et al., 2012).

Last but not least, many researchers criticize that the digital mathematics games used in many articles are drill-and-practice games that do not develop students' higher-order thinking skills (e.g., Byun & Joung, 2018; Fox, 2000; Jensen & Skott, 2022; Larkin, 2015; Lowrie & Jorgensen 2015; Van Eck, 2015). For instance, Lowrie and Jorgensen (2015) expressed that "the vast majority of digital mathematics games are designed only to improve students' basic mathematics and literacy skills" and that these games "are not being used to promote higher-order thinking and deep learning, but rather visually appealing drill-and-practice games" (p. 5). Similarly, Byun and Joung (2018) stressed that such digital games are limited to the repetition of simple calculations and do not develop higher-level thinking skills, which are essential for solving more complicated mathematical problems. Moreover, Van Eck (2015) criticized that such digital games do not provide answers to "our current need to promote problem-solving, transfer of learning, and learning to think mathematically" (p. 144). Additionally, Fox (2000) indicated that such drill-and-

practice games are a waste of time for students and argued that a sensitive mathematics teacher would not waste students' time "with pointless repetition of ideas that are already well assimilated" (p. 140).

Joung and Byun (2021) highlighted the importance of aligning the content of digital mathematics games with the process standards (i.e., problem-solving, reasoning and proof, communication, connections, and representations; National Council of Teachers of Mathematics, 2000) to promote higher-order thinking skills. In a recent systematic review study, Jensen and Skott (2022) focused on one of these process standards (i.e., mathematical reasoning) and attempted to understand how digital games might enhance students' development of mathematical reasoning based on the following reasons: (i) games can assist students in developing mathematical arguments, (ii) prior research reviews on digital mathematics games focused extensively on conceptual or procedural knowledge but not on specific processes, competences, or skills such as mathematical reasoning, and (iii) in the last twenty years, the importance of mathematical reasoning in elementary and middle school curricula has increased all over the world.

Based on the above-described explanations about and the contradictions and tendencies in the international literature on digital mathematics games, the current study attempted to provide a detailed synthesis of the national literature on digital mathematics games by conducting a systematic review of the peer-reviewed journal articles indexed in TR Index, DergiPark Academic, and Google Scholar.

Rationale and Research Questions

There are several rationales for conducting the current study. First, thus far, only a limited number of systematic literature reviews (meta-analyses in particular) have been conducted on digital mathematics games (e.g., Byun & Joung, 2018; Hussein et al., 2022; Tokaç et al., 2019; Uluçay & Çakır, 2014; Wouters et al., 2013; Yığ & Sezgin, 2021). Furthermore, research studies that conduct reviews on digital mathematics games in the national literature are almost non-existent. Indeed, after an extensive electronic database search and screening process, I could locate only 3 peer-reviewed journal articles two of which are systematic reviews (Uluçay & Çakır, 2014; Yığ & Sezgin, 2021) and one of which is a bibliometric analysis (Poçan, 2023). More specifically, Uluçay and Çakır (2014) systematically reviewed 37 journal articles, 8 dissertations, and 3 reports that were published between the years 2002 and 2012 indexed in Wiley Online Library, Science Direct, ACM Digital Library, ERIC (Education Resources Information Center), and Thesis Center of Turkish Council of Higher Education (Yükseköğretim Kurulu Başkanlığı Tez Merkezi). Meanwhile, Yığ and Sezgin (2021) systematically reviewed 71 peer-reviewed articles that were published from 2012 to 2019 in the Scopus database. Therefore, none of the two systematic literature reviews focused on peer-reviewed digital mathematics game articles in the national literature. Besides, Uluçay and Çakır (2014) reviewed dissertations and reports in addition to articles. Dissertations and reports are neither peer-reviewed nor formally published documents and, thus, are two specific types of grey literature (Jesson et al., 2011; Ridley 2012). Therefore, Uluçay and Çakır's (2014) systematic review might be lacking in methodological rigor due to including documents from the grey literature. For all these reasons, the national literature on digital mathematics games needs to be updated sooner through the conduction of systematic literature reviews focusing on peer-reviewed journal articles indexed in national databases.

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Second, educational games are games that are specifically designed to improve students' academic learning and boost their learning motivation (Mayer, 2014). Moreover, educational games should be designed in accordance with the learning objectives of the school curricula (MoNE, 2023). Thus, focusing on the learning domains of the digital mathematics game topics used in the articles published in national databases is important. Knowing which learning domains are emphasized and which ones are deemphasized in published articles can make an important contribution to the integration of digital games into mathematics classrooms.

Third, according to Ke (2016), research on educational games has focused mainly on reporting on the learning effectiveness of these games without a comprehensive description of game design elements and processes. However, researchers have not paid sufficient attention to examining whether authors of the peer-reviewed articles design their digital games or use the digital games developed by others. Furthermore, in case the digital game is designed as part of the research, it is important to investigate which environments are used to design this game and whether research participants are involved in the game development process. Therefore, systematic reviews of digital mathematics game articles focusing on designers and game design environments deserve more attention from researchers.

Ultimately, the documents selected by Byun and Young (2018), Tokaç et al. (2019), Wouters et al. (2013), Uluçay and Çakır (2014), Yığ and Sezgin (2021), and Hussein et al. (2022) for their systematic reviews were published between years 2005 and 2014, 2008 and 2016, 1990 and 2012, 2012 to 2019, 2002 and 2012, and 2008 and 2019, respectively. However, a systematic review that examines digital mathematics game articles published between 2019 and 2023 is lacking in the literature. Therefore, it is significant to conduct a systematic review that examines all digital mathematics game articles published until 2023 in the national literature. In this way, it would be possible to extend the findings of previous systematic literature reviews on digital mathematics games (Byun & Joung, 2018; Hussein et al., 2022; Tokaç et al., 2019; Uluçay & Çakır, 2014; Wouters et al., 2013 Yığ & Sezgin, 2021) and it would help to draw a more accurate and consistent picture about digital mathematics games.

Due to the rationales and research gaps described above, in this study, I focused on summarizing the research trends on digital mathematics games in the national literature and thereby gained a deeper understanding of the current status of research in this area. Besides, I provided an updated and detailed synthesis of the digital mathematics games literature by extracting data also from peer-reviewed research articles published between 2019 and 2023 and incorporating them into the existing body of literature on digital mathematics games. All told, I attempted to find answers to the following in the current study:

(1) What are the current research trends on digital mathematics games in the national literature?

(a) What are the aims of the selected peer-reviewed articles?

(b) What are the research methodologies used in the selected peer-reviewed articles?

(c) What are the participants of the selected peer-reviewed articles?

(d) What are the sizes of the samples recruited in the selected peer-reviewed articles?

(e) What are the designers of the digital mathematics games in the selected peer-reviewed articles?

(f) What are the environments used for designing the digital mathematics games in the selected articles

(g) What are the learning domains of the digital mathematics game topics used in the selected articles?

The findings of the current study can be used to inform policy decisions and professional practice in the field of digital mathematics games.

As cautioned by Byun and Joung (2018), without a careful analysis of their impacts on different learning outcomes, integrating digital games into mathematics classrooms "may turn out to be a waste of time and resources" (p. 9) for students. This signals the significance of evidence-based practices (i.e., systematic literature reviews) in informing "policy decisions and professional practice" (Ridley, 2012, p. 189). The current systematic review study attempts to progress in this direction. Namely, this study prevents, to some extent, stakeholders including curriculum developers, digital game designers, mathematics educators, teachers, and students from making uninformed decisions based on a single study by offering a summary of the available evidence garnered from the national literature on digital mathematics games.

Methodology

Research Design

There are broadly three different types of literature reviews as systematic reviews, traditional-narrative reviews, and hermeneutic–phenomenological reviews (Efron & Ravid, 2019; Jesson et al., 2011). When these literature review types are placed on a continuum, systematic reviews stand on one end of the continuum, hermeneutic–phenomenological reviews stand on another end of the continuum, and traditional literature reviews stand between these two opposite literature review types (Efron & Ravid, 2019).

Torgerson (2003) argued that, in educational research, systematic literature reviews are better than other literature review types due to being more rigorous and adopting a more strict scientific methodology. Besides, Greetham (2021) argued that synthesizing and evaluating studies by using systematic literature reviews can highlight discrepancies in the findings and provide policymakers with the information they need to decide whether to implement, change, or abandon a policy. Following these arguments, in the current study, I used a systematic literature review (Efron & Ravid, 2019; Greetham, 2021; Jesson et al., 2011; Newman & Gough, 2020; Ridley, 2012) to provide a detailed synthesis of the national literature on digital mathematics games, to gain a deeper understanding of the current status of research on digital mathematics games in the national literature, and consequently to highlight several research gaps to be filled by future researchers in this area.

Systematic literature reviews provide a systematic and transparent method of obtaining, synthesizing, and assessing the quality of study findings on a certain topic or question and the goal is to reduce the bias inherent in single research and non-systematic reviews (Kahn et al., 2011). Systematic literature reviews have many other distinct characteristics. They entail a "rigorous, systematic, comprehensive, and exhaustive search for *all* the relevant literature"; they use "focused, explicit, transparent (replicable), standardized, structured, and protocol-driven methodologies", and finally they are "objective, balanced, and unbiased" (Jesson et al., 2011, p. 103).

Following Greetham's (2021) explanations, I attempted to improve the transparency and reproducibility of the current systematic review by providing a repeatable methodology, which is sufficient in detail and clarity. For conducting a more systematic and explicit review, I not only provided a repeatable methodology but also overtly explained what was done and why it was done. Finally, I set, defined, and justified my own inclusion and exclusion criteria for the peer-reviewed articles from which I extracted the relevant data to enhance the comprehensiveness of the current review.

Electronic Sources Used

Databases, electronic libraries, electronic journals, and Google Scholar are potential electronic resources for systematic searching (Jesson et al., 2011). In the current study, I used the following electronic sources when searching for the keywords related to digital mathematics games: TR Index (TR Dizin; https://trdizin.gov.tr), Dergipark Academic (DergiPark Akademik; https://dergipark.org.tr/tr/), and Google Scholar (Google Akademik; https://scholar.google.com.tr/). The reason for selecting these electronic sources when conducting keyword searches is explained in some detail in the following paragraphs.

TR Index is a national electronic database that includes articles published in national, peer-reviewed scientific journals in the disciplines of Natural and Social Sciences (The Scientific and Technological Research Council of Türkiye [TÜBİTAK], 2023a). TR Index was founded in Türkiye by the Turkish Academic Network and Information Center (Ulusal Akademik Ağ ve Bilgi Merkezi) to activate the production of academic knowledge, to expand information services on a national scale, and to create equal opportunities among researchers in accessing scientific information (TÜBİTAK, 2023b). My reason for using the TR Index is that it includes the list of academic journals in which researchers in Turkish institutions have to publish several peer-reviewed articles due to the requirements declared by The Inter-University Council for associate professorship applications (TÜBİTAK, 2023c). Therefore, it is believed TR Index covers high-quality journal articles that facilitate critical appraisals. It is important to note that critical appraisals help to assess the soundness of the methods and results of academic sources and consequently that they are fundamental for conducting sound systematic reviews (Petticrew & Roberts, 2006).

DergiPark Academic is a national publication portal for academic journal articles. It supports the existence of national academic journals in accordance with the standards and helps to increase the international visibility of these journals. (TÜBİTAK, 2023d). However, DergiPark Academic is not an electronic database. Rather, it is an infrastructure service that provides electronic hosting and editorial process management for all journals in Turkey that declare to be academic and refereed. Within the scope of DergiPark Academic, there are not only journals indexed in TR Index, Web of Science, Scopus, DOAJ, and other national/international indexes or platforms but also journals that have just started publishing peer-reviewed articles and that are not included in any index yet (TÜBİTAK, 2023e). Thus, I used DergiPark Academic in addition to the TR Index for locating peer-reviewed digital mathematics game articles that might have not been indexed in the TR Index yet. That is, DergiPark Academic helped me to retrieve digital mathematics game articles that are not indexed in the TR Index yet.

Google Scholar is an academic search engine that "provides a simple way to do a broad search for scholarly literature, including peer-reviewed papers, theses, books, abstracts, and articles" (Fraenkel et al., 2023, p. 56). It

searches the whole internet by examining all of the material on millions of websites (Fraenkel et al., 2023). Therefore, my reason for using Google Scholar was that I wanted to widen my search outside of TR Index and DergiPark Academic to pick up more peer-reviewed articles on digital mathematics games and to locate the articles that are not displayed on TR Index and DergiPark Academic. To locate the journals and articles whose country of origin is Türkiye, I limited my search options only to "Turkish pages". However, Fraenkel et al. (2023) cautioned that Google Scholar must not be used in place of academic database searches. Therefore, I used Google Scholar results only as a complement to but not instead of TR Index and DergiPark Academic search results.

Keywords Searched in TR Index, DergiPark Academic, and Google Scholar

In the current study, to locate the peer-reviewed articles related to digital mathematics games, the following search terms (i.e., key words or key phrases) were formulated first: "oyun", "oyunlaştırma", "dijital", "video", "bilgisayar", "interaktif", "mobil", "ciddi", and "matematik". Second, the following key phrases were formulated through these key words: "dijital oyun", "video oyunu", "bilgisayar oyunu", "interaktif oyun", "mobil oyun", and "ciddi oyun". Third, using the Boolean operator "AND", these key phrases were combined with the term "matematik" to retrieve digital games articles that are related to mathematics. Finally, the following word combinations were searched in TR Index, DergiPark Academic, and Google Scholar: "dijital oyun" AND "matematik", "video oyunu" AND "matematik", "bilgisayar oyunu" AND "matematik", "interaktif oyun" AND "matematik", "mobil oyun" AND "matematik", and "ciddi oyun" AND "matematik".

Most of the peer-reviewed journals accessed through TR Index, DergiPark Academic, and Google Scholar published articles written in English as well. Therefore, to locate the digital mathematics game articles written in English, I conducted the same electronic search process described above and entered the following English equivalents of the aforementioned word combinations into TR Index, DergiPark Academic, and Google Scholar: "digital game" AND "mathematics", "video game" AND "mathematics", "computer game" AND "mathematics", "interactive game" AND "mathematics", "mobile game" AND "mathematics", and "serious game" AND "mathematics".

The electronic search began in January 2023 and continued until the last search in September 2023. To conduct an exhaustive search for all the relevant literature, I deliberately did not choose a cut-off date for the digital mathematics game articles published in peer-reviewed journals. Nevertheless, the electronic search results revealed that the oldest digital mathematics game article was published in 2005 while the most recent digital mathematics game article was published in 2023. Therefore, the current systematic review synthesized data from digital mathematics game articles published between the years 2005 and 2023.

After an initial search in the TR Index and DergiPark Academic, a total of 173 peer-reviewed articles on digital mathematics games were retrieved. Next, the duplicate articles and the ones that were not related to digital mathematics games were dropped and the total number of articles fell down to 78. These 78 peer-reviewed articles were subjected to a two-stage screening process. In the first stage, the titles and the abstracts of these peer-reviewed articles were examined. At the end of the first stage, 41 out of 78 peer-reviewed articles were identified as potentially

relevant for further analysis. In the second stage, the full texts of the 41 articles were examined in detail. At the end of the second stage, it was found that 22 articles suited to the purpose of the current study and thus were included in the systematic review. Moreover, Google Scholar was searched manually and 4 peer-reviewed articles that were relevant to the focus of the present study were identified. Overall, 26 peer-reviewed articles on digital mathematics games (see Appendix) were included in the systematic review process.

Inclusion and Exclusion Criteria

To make sure that the articles retrieved from the electronic search are relevant to the purpose of the current review and consequently to conduct a rigorous systematic analysis, I used several inclusion and exclusion criteria. I applied the following inclusion criteria for selecting appropriate digital mathematics game articles:

1. The country of origin of the peer-reviewed journals must be Türkiye.

2. The full texts of the peer-reviewed journal articles must be accessible.

3. The peer-reviewed journal articles must be written either in Turkish or English.

4. The digital games used in the peer-reviewed journal articles must be related to the teaching and learning of mathematics.

5. The terms "game" or "oyun" must be included either in the title or abstract of the peer-reviewed articles.

I applied the following exclusion criteria for selecting appropriate digital mathematics game articles:

1. Peer-reviewed journal articles focusing on non-digital games

2. Peer-reviewed journal articles that focus both on digital and non-digital games

3. Peer-reviewed journal articles focusing on digital game addiction

4. Conference papers, book chapters, and dissertations (grey literature) focusing on digital mathematics games

5. Peer-reviewed journal articles whose main focus is on other technological tools

6. Peer-reviewed STEM education articles that do not primarily focus on digital games

7. Peer-reviewed journal articles that are only about information technologies or computer science

8. Non-English and non-Turkish peer-reviewed journal articles on digital mathematics games

Coding Scheme and Data Coding

The peer-reviewed articles given in the Appendix were analyzed using the inductive content analysis method. In this method, codes, categories, and themes emerge as a result of researchers' long-term interaction with data (Patton, 2014). The codes used in the data coding process may come from the researcher himself/herself, from the literature, or the data set collected by the researcher (Yıldırım & Şimşek, 2008). In this systematic review, since there was no pre-established coding scheme through which the coders could categorize the data, the codes emerged from the data

set that was collected by the author. Briefly speaking, in this study, a data-driven approach (Namey et al., 2008) was used for data coding.

The coding scheme was developed after a thorough examination of the peer-reviewed articles selected for the current systematic review. This scheme consists of the following seven major categories or research trends (*i*) research aims of the selected articles, (*ii*) research methodologies of the selected articles, (*iii*) research participants of the selected articles, (*iv*) sample sizes of the selected articles, (*v*) designers of the digital mathematics games in the selected articles, (*vi*) environments used to design digital mathematics games, and (*vii*) learning domains of the digital mathematics game topics used in the selected articles.

The coding of data was initiated after the development of the coding scheme. During the data coding process, relevant data from each article were extracted manually, recorded in an Excel spreadsheet, and finally synthesized. I and another researcher who has a doctoral degree in mathematics education and considerable experience in qualitative data analysis conducted the coding. We independently coded the data by using the constant comparison strategy (Corbin & Strauss, 2015). This strategy refers to the "analytic process of comparing different pieces of data against each other for similarities and differences" (Corbin & Strauss, 2015, p. 85). I used Miles and Huberman's (1994) reliability formula (i.e., $reliability = \frac{the\ number\ of\ agreements}{the\ number\ of\ agreements\ +\ the\ number\ of\ disagreements}$) to calculate the degree of agreement between the two coders. The inter-rater reliability between me and another researcher ranged between 78% and 89% for the seven research trends mentioned above. Miles et al. (2014) recommend obtaining at least 85% inter-rater agreement, depending on the "size and range of the coding scheme" (p. 85). Hence, we scheduled three meetings to collaborate, settle disagreements, and establish a coding consensus. At the end of the third meeting session, we had almost reached a complete agreement and had completed the data coding process.

Results

In this section, the findings are reported based on the following categories or research trends: (*i*) research aims, (*ii*) research methodologies, (*iii*) research participants, (*iv*) sample sizes (*v*) designers of the digital mathematics games, (*vi*) the environment used to design digital mathematics games, and (*vii*) learning domains of the digital mathematics game topics.

Aims of the Selected Articles

Aims of the selected articles regarding digital mathematics games and their frequencies are presented in Table 1.

Table 1

Aims of the selected articles regarding digital mathematics games

Aims of the selected articles	Articles	*f*
To reveal participants' views, experiences, and awareness about digital mathematics games	A1*, A3, A5*, A8*, A13, A14, A15, A17, A18, A20*, A24	11
To explore the impact of a digital game on a dependent variable (e.g., achievement, attitude, and spatial orientation skills)	A1*, A2, A5*, A6, A7, A8*, A10, A19, A20*, A21	10
To review the literature about digital mathematics games and gamification in mathematics education	A4, A16, A25	3
To reveal participants' views about the digital mathematics game design process	A9, A23	2
To evaluate digital mathematics games in the Education Information Network (EBA) or ABCya! application	A22, A26	2
To explore the impact of designing digital mathematics games on creativity	A12	1
To design and develop a digital mathematics game	A11	1

Note. Studies denoted with asterisks (*) explored both the impact of a digital game on a dependent variable and the participants' views about digital games or gamification.

As presented in Table 1, 11 out of 26 articles (42%) aimed to reveal participants' views, experiences, and awareness about digital mathematics games. For instance, A14 explored pre-service primary school teachers' experiences with a mobile game related to the Fundamental Theorem of Arithmetic. As another example, A17 presented the experiences and views of a primary school teacher and 20 third-grade students on gamification in the classroom using the mobile game "Hoverland".

Exploring the impact of a digital mathematics game on a dependent variable also received similar attention from the authors of the selected articles. Namely, 10 out of 26 articles (38%) aimed to explore the impact of a digital game on participants' cognitive and affective domain skills. For instance, A6 focused on the impact of computer games on fifth-grade students' achievement in four operations with natural numbers. To give another example, A21 investigated the impact of a mobile game on sixth-grade students' attitudes towards mathematics.

However, only 3 articles (12%) reviewed the literature on digital mathematics games and gamification in mathematics education. For example, A16 presented an exploratory holistic analysis of digital gamification in mathematics education by focusing on 71 peer-reviewed articles in the Scopus database. Moreover, only two articles revealed participants' views on the design process of digital mathematics games. To give an example, A9 examined pre-service teachers' digital mathematics game designs and their views on the digital game design process. Similarly, 2 articles (8%) aimed at evaluating digital mathematics games in EBA (A22) and the ABCya! application (A26). Finally, one article was published for each of the following aims: exploring the impact of designing digital mathematics games on creativity (A12) and designing and developing a digital mathematics game (A11).

Research Methodologies of the Selected Articles

The research methodologies of the selected articles related to digital mathematics games are presented in Table 2.

Table 2.

Research methodologies of the selected articles related to digital mathematics games

Research methodologies	Articles	*f*
Case study research	A3, A9, A13, A14, A15, A17, A18, A23	8
Experimental research	A2, A6, A7, A10, A12, A19, A21	7
Documentary research	A4, A16, A22, A25, A26	5
Mixed methods research	A1, A5, A8, A20	4
Phenomenological research	A24	1
Other	A11	1

As shown in Table 2, 8 out of 26 articles (31%) preferred case study research and 7 out of 26 articles (27%) preferred experimental research. Five articles (19%) preferred to use documentary research methodology and 4 articles (15%) preferred to use mixed methods research. On the other hand, the use of phenomenological research was very scarce. That is, only A24 used this research methodology. Finally, A11 designed and developed a digital mathematics game on transformation geometry (entitled "Simetri") and explained the design process of this game thoroughly. However, A11 did not report the research methodology used. Therefore, A11 was coded as "Other".

Participants of the Selected Articles

Participants of the selected articles related to digital mathematics games are presented in Table 3.

Table 3.

Participants of the selected articles

Participants of the selected articles	Articles	*f*
Middle school students (grades 5 – 8)	A1*, A2, A6, A7, A8, A20, A21	7
Primary school students (grades 1 – 4)	A1*, A5, A10, A17**, A19	5
Pre-service primary school teachers	A3, A12, A13, A14	4
Pre-service mathematics teachers	A9, A18, A23, A24	4
Primary school teachers	A17**	1
Mathematics teachers	A15	1
Does not involve human participants	A4, A11, A16, A22, A25, A26	6

*Fourth- and fifth-grade students, **third-grade students and a primary school teacher

As presented in Table 3, 7 articles (27%) were conducted with middle school students and 5 articles (19%) were conducted with primary school students. That is, 11 out of 26 articles (42%) were conducted with primary and middle school students (Note that A1 included both primary and middle school students as participants). Eight out of 26 articles (31%) were conducted with pre-service teachers, 4 with pre-service primary school teachers and 4 with

pre-service mathematics teachers. However, authors of digital mathematics game articles seldom used in-service teachers as research participants. Namely, only A17 was conducted with primary school teachers and only A15 was conducted with mathematics teachers. The remaining 6 articles (23%) do not involve human participants. In more detail, A4, A16, and A25 are review studies related to digital mathematics games and gamification in mathematics education. As mentioned in the "Participants of the Selected Articles" subsection, A11 designed a digital mathematics game entitled "Simetri". However, it did not empirically test its effectiveness with learners. Therefore, A11 did not involve human participants. Lastly, A22 is documentary research that examined the middle school level digital mathematics games in EBA based on the Bloom taxonomy and A26 is another documentary research that examined the games in ABCya! application (https://www.abcya.com/) based on the learning trajectories for the development of number concepts. Thus, these articles did not include human participants as well.

Sample Sizes in the Selected Articles

Sample sizes in the selected articles related to digital mathematics games are presented in Table 4.

Table 4.

Sample sizes in the selected articles

Sample sizes	Articles	f
Between 5 and 10	A15, A3	2
Between 11 and 20	A13, A24, A14, A19	4
Between 21 and 30	A17, A20, A12, A18, A21, A7, A9	7
Between 31 and 40	A23	1
Between 41 and 50	A1, A5, A6, A8	4
Between 100 and 150	A10	1
Between 150 and 200	A2	1
Does not involve human participants	A4, A11, A16, A22, A25, A26	6

Note. In the "Articles" column, the articles are listed from smallest to largest in terms of their sample sizes.

As can be calculated from Table 4, in 11 out of 26 articles (42%), the sample size was between 11 and 30. More specifically, there are 7 studies (27%) with a sample size between 21 and 30 participants and 4 studies (15%) with a sample size between 11 and 20. Likewise, there are 4 studies (15%) with a sample size between 41 and 50 participants. On the other hand, the remaining sample sizes reported in Table 4 were less frequently preferred by the articles. In other words, A3 and A15 had a sample size between 5 and 10, A23 had a sample size between 31 and 40, A10 had a sample size between 100 and 150, and finally A2 had a sample size between 150 and 200. As mentioned in the "Participants of the Selected Articles" subsection, A4, A11, A16, A22, A25, and A26 do not include human participants. Therefore, sample sizes were naturally not reported in these articles.

Designers of the Digital Mathematics Games in the Selected Articles

Designers of the digital mathematics games in the selected articles are presented in Table 5.

Table 5.

Designers of the digital mathematics games in the selected articles

Designers of the digital game		Articles	f
Designed within the scope of the study	Designed by the researcher	A2, A7, A10, A11, A13, A14, A21	7
	Designed by the participants	A9, A12, A23, A24	4
	Designed by individuals who are not actual participants	A15	1
Taken directly from online sources	Taken directly from the Internet or digital game development companies	A1, A3, A6, A17, A18, A19, A20, A26	8
	Taken directly from the educational content network entitled EBA	A8, A22	2
	Taken directly from the online educational platform entitled Vitamin	A5	1
Not Applicable		A4, A16, A25	3

As shown in Table 5, the digital mathematics games used in the selected articles were either created ($n = 12$, 46%) or directly taken from online sources ($n = 11$, 42%). The digital mathematics games in the first category were either created by the authors of the articles, research participants, or individuals who were not actual research participants ($n = 1$, 4%). In more detail, the digital mathematics games in 7 articles (27%) were designed by the researchers. For instance, in A13, the researchers designed a digital game to introduce the Euclid Division to pre-service primary school teachers by using the Java language in the Android Studio environment. In 4 articles (15%), the digital mathematics games were designed by the research participants. To give an example, A23 aimed to provide pre-service middle school mathematics teachers with the experience of designing digital games, to explore their opinions, and to evaluate the games they designed. Within the scope of A23, pre-service middle school mathematics teachers designed their digital games by using an application called Draw Your Game, which can be downloaded for free from Playstore or App Store. The digital mathematics games in 1 article (A15; 4%) were designed by individuals who are not actual participants. That is, A15 explored in-service mathematics teachers' views on the digital mathematics games designed by pre-service mathematics teachers using Scratch. The pre-service teachers designed 13 digital mathematics games related to algebraic expressions and then six middle school mathematics teachers evaluated these digital games by using rubrics.

The digital mathematics games in the second category were either taken from the internet and game development companies, educational platforms, or content networks. In more detail, the digital mathematics games in 8 articles (31%) were taken directly from the internet or digital game development companies. For example, A18 used the online game Monty Hall Simulation, which was provided by a mathematics website. Moreover, in 2 articles (A8 and A22; 8%), the researchers used digital mathematics games delivered through the educational content network entitled EBA. For instance, in A22, which is an example of documentary research, the researchers evaluated the middle school mathematics games included in EBA based on Bloom's taxonomy.

The Environments Used to Design Digital Mathematics Games in the Selected Articles

The environments used to design digital mathematics games in the selected articles are presented in Table 6.

Table 6.

The environments used to design digital mathematics games in the selected articles

The environments used to design digital mathematics games	Articles	*f*
Scratch	A9, A15, A24	3
Android Studio	A13, A14	2
C#	A10	1
Construct 2	A11	1
Draw your game	A23	1
Not mentioned	A2, A7, A12, A21	4
The digital mathematics games were designed previously by other researchers, institutions, or organizations	A1, A3, A5, A6, A8, A17, A18, A19, A20, A22, A26	11
Not Applicable	A4, A16, A25	3

As shown in Table 6, one of the environments used to design digital mathematics games in the selected articles is Scratch. 3 articles (12%) preferred to use the Scratch program to design digital mathematics games. For instance, A24 explored pre-service teachers' awareness of digital games. In A24, pre-service teachers designed digital mathematics games using Scratch. In 2 articles (A13 and A14; 8%), the researchers preferred to use the Android Studio to design digital mathematics games. For instance, in A14, the researchers designed the Bacterial Colony Game by using Android Studio to investigate pre-service teachers' exploration of the Fundamental Theorem Of Arithmetic through a mobile game.

In one article (3%), the researchers used C# for designing digital games. Namely, in A10, the researchers designed a snake game using the C# programming language. In another article (A11; 3%), the researchers designed and developed a digital mathematics game on transformation geometry by using Construct 2. Finally, in A23 (3%), pre-service mathematics teachers designed digital games by using the program entitled Draw Your Game.

As demonstrated in Table 6, in 4 articles (15%), the researchers did not explicitly mention the name of the environment they used to design the digital games. The digital mathematics games used in 11 articles (42%) had previously been designed by other researchers, institutions, or organizations. Last, 3 articles (12%) reviewed the literature on digital mathematics games and gamification in mathematics education and they did not include digital mathematics games.

Learning Domains of the Digital Mathematics Game Topics Used in the Selected Articles

Learning domains of the digital mathematics game topics used in the selected articles are presented in Table 7.

Table 7.

Learning domains of the digital mathematics game topics used in the selected articles

Learning domains	Articles	f
Numbers and operations	A1, A2, A3*, A5, A6, A7, A8, A10, A13, A14, A17**, A19, A21, A26	14
Multiple learning domains	A9, A12, A22, A23, A24	5
Geometry	A11, A17**, A20	3
Measurement	A3*	1
Algebra	A15	1
Not indicated	A18	1
Not Applicable	A4, A16, A25	3

Note. *A3 selected mathematical topics from both Numbers and Operations and Measurement learning domains. **A17 selected mathematical topics from both Numbers and Operations and Geometry learning domains

As presented in Table 7, in more than half of the articles ($n = 14$; 54%) the mathematical topics of the digital games were selected from the Numbers and Operations learning domain. For instance, A1 investigated the effect of educational computer games on students' arithmetical operation skills. Similarly, in A2, the effects of educational computer games on students' attitudes towards mathematics and educational computer games were investigated and the authors developed two games called "Proportional Tetris" and "Proportional Clown" related to the topic of ratio-proportion for seventh-grade students.

In 5 articles (19%), the digital mathematics game topics were from multiple learning domains. However, in very few articles the topics of the digital games were selected from Geometry ($n = 3$; 12%), Algebra ($n = 1$, 4%), and Measurement ($n = 1$, 4%) learning domains. For instance, A11 developed a digital game on transformation geometry. A20 investigated the effect of the video game Euro Truck Simulator 2 on the spatial orientation and entrepreneurial skills of gifted children. In A15, pre-service teachers designed digital mathematics games related to algebraic expressions. None of the articles reviewed in the current study used digital games that were directly related to data analysis and statistics. Last, A18 did not explicitly indicate the learning domain from which the mathematical topic of the digital game was selected.

Discussion and Implications

The current study attempted to provide a detailed synthesis of the literature on digital mathematics games by conducting a systematic review of the peer-reviewed journal articles whose country of origin is Türkiye. The selected articles were synthesized by considering the following research trends: research aims, research methodologies, research participants, sample sizes, designers of the digital mathematics games, environments used to design the digital mathematics games, and the learning domains of the digital mathematics game topics. In the following paragraphs, the findings are discussed based on these research trends.

Research Aims

The results of this study showed that nearly half of the articles aimed to reveal learners' views, experiences, and awareness about digital mathematics games ($n = 11$; 42%). A partial explanation for the interest in this trend is that the authors might have preferred to conduct research on digital mathematics games based on research gaps in this area. However, this trend was much less evident in the study of Byun and Joung (2018). They selected 33 digital mathematics game articles from EBSCOhost Online, ERIC, PsycINFO, Social Science Citation Index, and Science Citation Index and found that only one article (3%) examined participants' perceptions and thoughts about digital mathematics games.

Similarly, less than half of the articles aimed to examine the impact of digital mathematics games on learners' achievement, attitude, and spatial orientation skills ($n = 10$; 38%). A plausible explanation for this trend is that the authors might have believed that merely exploring learners' views, experiences, and awareness about digital mathematics games may not resolve the current issues about digital mathematics games and the effectiveness of these games in mathematics instruction and this belief might have encouraged them to identify these issues and test the impacts of digital mathematics games on students' different learning outcomes. Previous systematic review studies on digital mathematics games (e.g., Byun and Joung, 2018; Pan et al., 2022) also pointed out the need for testing the educational effectiveness of digital mathematics games. For instance, Pan et al. (2022) examined how games are utilized for mathematics learning and identified game design aspects that improved effective mathematics learning. To retrieve the appropriate articles that met their goal, they searched in JSTOR, ERIC, EBSCO, Psych Info, Dissertation Abstracts, and ACM. They revealed that previous review studies lacked essential and contextual information about the features and strategies used in game design that control how learning and gameplay are integrated.

On the other hand, the current study showed that conducting literature reviews ($n = 3$, 12%), identifying learners' views about mathematics game design processes ($n = 2$, 8%), evaluating the digital mathematics games delivered through EBA or ABCya! application ($n = 2$, 8%), examining the effect of designing digital mathematics games on creativity ($n = 1$, 4%), and developing digital mathematics games ($n = 1$, 4%) received scant attention from the authors of the digital mathematics game articles. The lack of research on learners' views, experiences, and evaluations of mathematics game design processes was also stressed in previous research studies (e.g., Aldemir Engin, 2022; Ke & Abras, 2013; Ke, 2016; Pan et al., 2022; Yıldız Durak & Karaoğlan Yılmaz, 2019). Pan et al. (2022) contended that there is still a dearth of empirical and theoretical research on the impact of digital game design and usage on students' learning of mathematics. Ke (2016) complained that educational game researchers focused mainly on reporting on the learning effectiveness of games without a comprehensive description of game design elements and processes. She recommended that researchers should present a phenomenological account of their experiences in creating educational games, focusing on the theoretical underpinnings, general design principles, design rationale for game mechanics and game world design, as well as important takeaways and suggestions.

Research Methodologies

In this study, it was found that authors of the digital mathematics game articles used case studies ($n = 8$, 31%) and experimental research designs ($n = 7$, 27%) more prevalently when compared to mixed methods ($n = 4$, 15%), documentary ($n = 5$, 19%), and phenomenological research designs ($n = 1$, 4%). The popularity of case study designs in the selected articles can be attributed to the fact that the authors attempted to match the aims of their studies with relevant research designs. That is, the authors of A3, A13, A14, A15, A17, and A18 explored in-depth learners' views, experiences, and awareness about digital mathematics games, while the authors of A9 and A23 explored participants' views about digital mathematics game design process and to achieve their purposes, these authors used a case study design as this research methodology best suits their research goals.

Previous systematic reviews reported similar findings with respect to experimental research designs and found that the majority of the selected articles on digital mathematics games adopted this research design as their research methodologies (e.g., Byun & Joung, 2018; Pan et al., 2022). Byun and Joung (2018) revealed that 30 out of 33 digital mathematics game articles (91%) used quantitative and mixed methods research designs while only three articles (9%) used qualitative research designs. Similarly, Pan et al. (2022) reviewed digital mathematics game articles using both experimental and non-experimental research designs and found that 40 out of 43 articles (93%) used experimental research designs, while two of them (4.6%) used qualitative research designs and one of them (2.4%) used a design-based research methodology. Furthermore, Yığ and Sezgin (2021) reviewed 71 peer-reviewed articles in the SCOPUS database to uncover the main problems, intentions, and trends in digital mathematics games and they found that in 28 out of 71 articles (39%), experimental designs were used as research methodologies

The fact that experimental study designs were most frequently used as research methodologies in the selected articles on digital mathematics games may be ascribed to the fact that only in experimental studies it can be ascertained that the observed results on students' critical learning outcomes (e.g., mathematics achievement) in an experiment are produced by the treatment (e.g., a certain teaching approach, a newly established curriculum, or an instructional program) but not by extraneous factors (Avcu & Avcu, 2022). Another plausible explanation for the common use of experimental designs is that studies with such methodologies have a great impact on the educational policies and practices implemented in all countries around the world (Borman et al., 2005; Slavin, 2008). Besides, researchers are increasingly encouraged to conduct studies with more rigorous methodological designs such as randomized controlled trials to benefit from the funding opportunities provided by public or private agencies (Hedges & Schauer, 2018).

On the contrary, the findings of this study indicated that survey research methodology was not preferred by the authors of the selected articles on digital mathematics games. Pan et al. (2022) also reported that they did not review any article that uses a survey design. Additionally, Yığ and Sezgin (2021) revealed that, of the 71 peer-reviewed articles on digital mathematics games, only one of them (1%) used survey research methodology. However, survey studies have many advantages since they are relatively simple to administer; are cost-effective; enable gathering information from a huge number of people in a very limited time; can be conducted remotely through e-mails, telephones, and mobile devices; provide a great deal of freedom for data analysis; and enable collection of a wide

variety of data including attitudes, opinions, beliefs, values, behaviors, and facts (Cohen et al., 2018; Mills & Gay, 2019). Therefore, digital game researchers should conduct many survey studies to reveal a large number of teachers' views, experiences, and evaluations about the application of digital mathematics games in mathematics classrooms. In this way, it can be understood how and to what extent digital games are integrated into teachers' mathematics teaching practices in real classroom settings.

Research Participants

The findings showed that digital mathematics game authors recruited pre-service teachers, middle school students, primary school students, and in-service teachers as research participants in eight (31%), seven (27%), five (20%), and two articles (8%), respectively. However, the systematic literature review on digital mathematics games appears to be contradictory in terms of the educational background of research participants (e.g., Byun & Joung, 2018; Hussein et al., 2022; Pan et al., 2022; Tokaç et al., 2019; Uluçay & Çakır, 2014; Yığ & Sezgin, 2021). For instance, Uluçay and Çakır (2014) systematically reviewed articles, dissertations, and reports indexed in Wiley Online Library, Science Direct, ACM Digital Library, ERIC, and Thesis Center of Turkish Council of Higher Education and reported that in the digital mathematics game studies they reviewed, middle school students ($n = 18$, 42%) were the most frequently recruited research participants compared to primary school students ($n = 10$, 23%), high school students ($n = 4$, 9%), pre-school students ($n = 3$, 6%), and university students ($n = 3$, 6%). On the other hand, other systematic review studies found that primary school students were the most frequently recruited research participants in reviewed the digital mathematics game articles (Byun & Joung, 2018; Hussein et al., 2022; Pan et al., 2022; Tokaç et al., 2019; Yığ & Sezgin, 2021). In more detail, 30 out of 43 studies (70%) in Hussein et al. (2022), 22 out of 33 studies (66%) in Byun and Joung (2018), 16 out of 24 studies (66%) in Tokaç et al. (2019), 20 out of 43 studies (46%) in Pan et al. (2022), and 24 out of 65 studies (37%) in Yığ and Sezgin (2021) used primary school students as research participants.

Hussein et al. (2022) employed the Social Sciences Citation Index to find digital game-based learning interventions in mathematics education. As argued by Hussein et al. (2022), one possible reason for the authors' recruitment of primary and middle school students but not high school students as research participants in the digital mathematics game articles selected for the current study is that digital games may naturally be more enjoyable and pleasant for primary and middle school students than for high school students. Additionally, digital mathematics game researchers might be opting to concentrate on primary and middle school students since these students are less burdensome and easier to please than high school students who would need complex and advanced digital game-based learning applications.

It is important to note that in the current systematic review, only two articles on digital mathematics games selected in-service teachers as research participants. For this reason, conducting digital mathematics game research with in-service teachers as study participants may play an essential but partial role in closing the research gap in the digital mathematics games literature.

Sample Sizes

In this study, the findings indicated that in one article (A2, 4%) the number of participants ranged between 150 and 200; in another article (A10, 4%) the number of participants ranged between 100 and 150; in four articles (15%) the number of participants ranged between 41 and 50; in one article (A23, 4%) the number of participants ranged between 31 and 40; in seven articles (27%) the number of participants ranged between 21 and 30; in another four articles (15%) the number of participants ranged between 11 and 20; and finally, in two articles (4%) the number of participants ranged between 5 and 10. Note that I reviewed only two articles (A2, A10; 8%) in which there were more than 50 participants. This finding appears contradictory to the findings of Pan et al. (2022) who reported that 34 out of 43 articles (79%) reviewed in their study had medium to large sample sizes ranging between 50 and 435. More specifically, Pan et al. (2022) revealed that 9 out of 43 articles (20.9%) had a sample size of less than 50, 23 articles (53.5%) had a sample size ranging between 50 and 200, and 11 articles (25.6%) had a sample size ranging between 200 and 435.

In this study, in seven case study articles (A3, A9, A13, A14, A15, A17, and A18; 27%) the number of participants ranged between 5 and 30. This finding is not surprising since qualitative research studies are often carried out with small samples of less than 30 individuals (Pan et al., 2022). Despite this, in one case study article (A23, 4%) 39 middle school mathematics teachers were selected as study participants. Additionally, in one phenomenological research article (A24; 4%) the number of participants ranged between 11 and 20. Therefore, it can be suggested that the authors of qualitative research articles on digital mathematics games were often inclined to match their research methodologies with relevant sample sizes.

On the other hand, in four digital mathematics game articles that used experimental research design methodology (A7, A12, A19, and A21; 15%), the sample size was less than 30. This means that there were less than 30 participants in each of their experimental and control groups. The authors of widely used educational research textbooks (e.g., Ary et al., 2014; Fraenkel et al., 2023; Mills & Gay, 2019) proposed that each cell or group (i.e., experimental and control groups) should include at least 30 participants. This cut-off value is particularly significant for experimental research designs because a sample size of less than 30 for each group may result in insufficient statistical power and consequently may jeopardize the validity of the experimental study (Cheung & Slavin, 2012). Therefore, authors of the experimental research articles on digital mathematics games should recruit a considerably greater number of participants in their studies (i.e., at least a total of 60 participants) to improve the statistical power of their studies and eliminate Type I and Type II errors.

Designers of the Digital Mathematics Games and Environments Used to Design the Digital Mathematics Games

The findings of this study demonstrated that the digital mathematics games used in the selected articles were either created ($n = 12$, 46%) or directly taken from online sources ($n = 11$, 42%). The digital mathematics games in the first category were either created by the authors of the articles ($n = 7$, 27%), research participants ($n = 4$, 15%), or individuals that were not actual research participants ($n = 1$, 4%). The digital mathematics games in the second category were either taken from the internet and game development companies ($n = 8$, 27%), educational platforms,

or content networks entitled EBA and Vitamin ($n = 3$, 12%). The finding that the authors of the selected articles preferred to create their digital mathematics games rather than rely on pre-existing digital mathematics games is supported by Pan et al. (2022) who uncovered that more researchers favored developing a new game from Scratch or modifying an existing game ($n = 22$, 51%) than adopting from existing games depending on the research goals ($n = 19$, 44%). However, this finding is somewhat in contrast with the findings of Tokaç et al. (2019) who searched in ERIC, PsycINFO, Wilson, Google Scholar, JSTOR, and ISI Web of Science databases to locate the peer-reviewed journal articles, book chapters, dissertations, and conference papers that focused on the impacts of computer games on students' achievement in mathematics. They demonstrated that in 9 out of 24 studies reviewed (37.5%), the digital games were developed by the study authors, while in the remaining 15 studies (62.5%) the digital games were pre-existing games already developed by other individuals or institutions (i.e., DimensionM, iPad math games, Slope game, Gem game, Brain Age 2, MySims, Astra Eagle, VmathLive, Sims 2–Open for Business, Chartworld, Skills Arena, Lure of the Labyrinth, and Goldilocks series games).

It is desirable that the digital mathematics games used in empirical research studies are designed by the authors or participants of these studies. Providing the study participants with the opportunity to create or modify digital mathematics games and involving them in digital game design processes is extremely crucial because, as emphasized by Tokaç et al. (2019), one aspect influencing the relationship between "digital game-based learning" and "mathematics achievement" is the design characteristics of digital mathematics games. Therefore, future researchers may concentrate more on how and why design futures of digital mathematics games influence students' different learning outcomes such as mathematics achievement, attitudes towards mathematics, or motivation to learn mathematics.

Another important finding of the present study is that three articles (A9, A15, and A24; 12%) used the Scratch programming language, two articles (A13 and A14; 8%) used the Android Studio application, one article (A10; 4%) used the C# programming language, another article (A11; 4%) used the Construct 2 digital game engine, and finally one another article (A23; 4%) used the Draw Your Game application as environments used for designing digital mathematics games. Unfortunately, this research trend has not been examined in many of the existing systematic literature reviews (e.g., Byun & Joung, 2018; Hussein et al., 2022; Pan et al., 2022; Tokaç et al., 2019; Uluçay & Çakır, 2014; Wouters et al., 2013; Yığ & Sezgin, 2021). Therefore, research that explores how digital games that are designed in different environments contribute to students' mathematics achievement or attitude is warranted to fill the aforementioned research gap in the literature on digital games.

Learning Domains of the Digital Mathematics Game Topics

In this study, in more than half of the articles ($n = 14$; 54%) the mathematical topics of the digital games were selected from the Numbers and Operations learning domain. In previous literature review studies, it was also reported that the reviewed articles selected the topics of their digital games mostly from Numbers and Operations learning domain (e.g., 29 out of 43 articles [67%] in Hussein et al., 2022; 15 out of 23 digital mathematics games [65%] in Joung & Byun, 2021; 24 out of 43 articles [56%] in Pan et al., 2022; and 16 out of 33 articles [48%] in Byun & Joung, 2018).

On the other hand, it was found in this study that in very few articles the topics of the digital games were selected from Geometry ($n=3$; 12%), Algebra ($n = 1$, 4%), and Measurement ($n = 1$, 4%) learning domains. As was the case in the present study, in some review studies, it was revealed that the topics of the digital games were selected less frequently from Geometry learning domain (e.g., 7 studies [21%] in Byun & Joung, 2018; 3 digital games [13%] in Joung & Byun, 2021; 3 studies [%7] in Pan et al., 2022; and one study [%2] in Hussein et al., 2022). However, in these review studies, it was also found that the topics of the digital games were selected more frequently from the Algebra learning domain compared to the present study findings (e.g., 12 studies [36%] in Byun & Joung, 2018; 6 studies [26%] in Joung & Byun, 2021; and 5 studies [11%] in Hussein et al., 2022). Similar to the present study findings, Joung and Byun (2021) found that only in 3 out of 23 digital games (13%) the mathematical topic was selected from the Measurement learning domain while Byun and Joung (2018) found that in only 5 out of 33 articles (15%) the mathematical topics of the digital games were selected from this learning domain.

It is worthy of note that in none of the articles reviewed in the current study, the mathematical topics of the digital games were selected from the Data Analysis and Probability learning domain. This was also the case in the studies of Joung and Byun (2021) and Hussein et al. (2022). Meanwhile, Byun and Joung (2018) reported that they reviewed only one article (2.3%) in which the mathematical topic of the digital game was selected from the Data Analysis and Probability learning domain.

With respect to the learning domains from which the mathematical topics were selected, the present study findings demonstrated that authors of the digital mathematics game articles showed particular interest in Numbers and Operations. One possible explanation for this interest is that the Numbers and Operations learning domain forms the basis of other learning domains and is fundamental for improving students' achievement in mathematics (Geary, 2011). In more detail, in many school mathematics curricula (e.g., Common Core State Standards for Mathematics, 2010; MoNE, 2018) mathematical topics from the Numbers and Operations learning domain are introduced first to the students. After developing their essential understanding of mathematical topics in the Numbers and Operations learning domain, the students are expected to extend and transfer these understandings to the other learning domains and thereby develop a better understanding of a wide variety of mathematical topics from all learning domains.

Ultimately, based on the findings explained above, it can be recommended that researchers design digital games for teaching mathematical topics related to Data Analysis and Probability, Algebra, Measurement, and Geometry learning domains and delve deeper into the reasons for the lack of digital mathematics games in these domains.

Ethics

The current study is a systematic review of digital mathematics games and does not involve human participants. Therefore, ethical approval is not required in this study.

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Appendix: Peer-Reviewed Journal Articles Selected for the Systematic Review

In this section, digital mathematics game articles published in national peer-reviewed journals from 2005 to 2023 are listed.

Article IDs	References
A1	Kula, A., & Erdem, M. (2005). The effect of educational computer games on the development of basic arithmetic operation skills. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 29*, 127–136.
A2	Çankaya, S. ve Karamete, A. (2008). Eğitsel bilgisayar oyunlarının öğrencilerin matematik dersine ve eğitsel bilgisayar oyunlarına yönelik tutumlarına etkisi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 4*(2), 115–127.
A3	Topçu, H., Küçük, S. ve Göktaş, Y. (2014). Sınıf öğretmeni adaylarının ilköğretim matematik öğretiminde eğitsel bilgisayar oyunlarının kullanımına yönelik görüşleri. *Turkish Journal of Computer and Mathematics Education, 5*(2), 119–136. https://doi.org/10.16949/turcomat.09768
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A8	Türkmen, G. P. & Soybaş, D. (2019). The effect of gamification methodology on students' achievements and attitudes towards mathematics. *Bartın University Journal of Faculty of Education, 8*(1), 258–298. https://doi.org/10.14686/buefad.424575
A9	Yıldız Durak, H. ve Karaoğlan Yılmaz, F. G. (2019). Öğretmen adaylarının matematik öğretimine yönelik eğitsel dijital oyun tasarımlarının ve tasarım sürecine ilişkin görüşlerinin incelenmesi. *Ege Eğitim Dergisi, 20*(1), 262–278. https://doi.org/10.12984/egeefd.439146
A10	İncekara, H., & Taşdemir, Ş. (2019). The design of a digital game for developing four operations skills in mathematics and its effects on student success. *Gazi Mühendislik Bilimleri Dergisi, 5*(3), 227–236. https://doi.org/10.30855/gmbd.2019.03.03
A11	Navruz, M., & Taşdemir., Ş. (2019). Design and development of an educational digital game based on mathematics course transformation geometry. *International Journal of Applied Mathematics Electronics and Computers, 7*(4), 88–95. https://doi.org/10.18100/ijamec.597156
A12	Aksoy, N. C. ve Küçük Demir, B. (2019). Matematik öğretiminde dijital oyun tasarlamanın öğretmen adaylarının yaratıcılıklarına etkisi. *Gazi Üniversitesi Gazi Eğitim Fakültesi Dergisi, 39*(1), 147–169. https://doi.org/10.17152/gefad.421615
A13	Gök, M., İnan, M. ve Akbayır, K. (2020). Sınıf öğretmeni adaylarına Öklid bölmesinin bir mobil oyunla tanıtılması. *Cumhuriyet International Journal of Education, 9*(1), 219–242. http://dx.doi.org/10.30703/cije.560761
A14	Gök, M. (2020). Sınıf öğretmeni adaylarının bir mobil oyun deneyimi: Aritmetiğin temel teoremi. *Journal of Computer and Education Research, 8*(15), 41–74. https://doi.org/10.18009/jcer.643732

A15	Gökkurt Özdemir, B., Basır, R., Balbay, A., Meredova, P., & Çağlar, K. (2021). Digital games designed by prospective teachers in the scratch program through the eyes of mathematics teachers. *International Journal on Lifelong Education and Leadership, 7*(2), 37–58. https://doi.org/10.25233/ijlel.994301
A16	Yığ, K. G., & Sezgin, S. (2021). An exploratory holistic analysis of digital gamification in mathematics education. *Journal of Educational Technology and Online Learning, 4*(2), 115–136. https://doi.org/10.31681/jetol.888096
A17	Kara, N. (2021). Eğitsel mobil matematik oyunu ile sınıf içi oyunlaştırma: Bir durum çalışması örneği. *Muğla Sıtkı Koçman Üniversitesi Eğitim Fakültesi Dergisi, 8*(1), 85–101. https://doi.org/10.21666/muefd.764044
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A20	Yılmaz, E., Yıldırım, Y. & Arıkan, A. (2022). Exploring the effect of video games on gifted children's spatial orientation and entrepreneurial skills. *E-International Journal of Educational Research, 13*(5), 238–257. https://doi.org/10.19160/e-ijer.1150405
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A22	Günbaş, N. ve Öztürk A., N. (2022). Eğitim Bilişim Ağı (EBA) içeriklerinde yer alan dijital matematik oyunlarının Bloom taksonomisine göre incelenmesi. *e- Kafkas Eğitim Araştırmaları Dergisi, 9*(1), 253–278. https://doi.org/10.30900/kafkasegt.1009879
A23	Aldemir Engin, R. (2023). Matematik öğretmeni adaylarının dijital oyun tasarlama deneyimleri, görüş ve değerlendirmeleri: Draw your game örneği. *ODÜ Sosyal Bilimler Araştırmaları Dergisi, 13*(1), 89–114. https://doi.org/10.48146/odusobiad.1103234
A24	Avcu, S. (2023). Matematik öğretmen adaylarının Scratch ile tasarlanan dijital matematik oyunlarıyla ilgili farkındalıkları. *Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 20*(1), 126–149. https://doi.org/10.33711/yyuefd.1178451
A25	Poçan, S. (2023). Matematik eğitiminde dijital oyun tabanlı öğrenme üzerine bibliyometrik analiz. *İnönü Üniversitesi Eğitim Fakültesi Dergisi, 24*(1), 648–669. https://doi.org/10.17679/inuefd.1215903
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Examining Parental Alienation Behaviors in Divorce, Custody and Personal Relationship Cases

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Abstract

In this study, the objective was to conduct an analysis of behaviors associated with Parental Alienation Syndrome (PAS) within the context of divorce, custody disputes, and personal relationship with children. The present inquiry employed the document/text analysis method, one of the qualitative research methodologies. The reports prepared by psychologists, social workers, and pedagogues (psychological counsellors), including the researcher, in the cases held by Ankara 10th Family Court were included in the study. 27 selected files were descriptively analyzed with respect to PAS behaviors and alienation strategies. Answers were sought to the questions about PAS behaviors toward mother, father and relatives, and what PAS behaviors are in court processes and relations with the child. Results showed that parental alienation behaviors toward parents and relatives are common in divorce, custody, and personal relationship with the child cases. It was found that divorce, custody, and personal relationship with the child cases negatively affect the relationship between the mother, the father, and the child. The research findings, PAS behaviors put all the parties in a difficult situation in the legal process. Therefore, providing psychosocial services to the families, raising the awareness of court experts about PAS, and conducting more research on this issue are important.

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Concepts

Family is the system that constitutes the basis of society and is important for children. It is an environment in which the natural needs of children such as love, affection, care, and protection are met. As a result of the inability to solve the problems that emerge in the family, integrity of the family could be disrupted, and couples get divorced. The marriage contract established between a man and woman based on laws might be terminated by court order within the framework of laws. Yörükoğlu (2023) defines divorce as a complicated procedure that emerges as a result of the termination of marriage contract, leads to the psychological breakup of the family bond, and affect all members of the family. The incidence of divorce in Turkey has witnessed a notable upsurge over the past decade. According to statistics compiled by the Turkish Statistical Institute (TUIK), a total of 180.592 divorce cases were recorded in 2022. As a result of final verdicts of divorce cases, it is seen that custody decision was given for 180,592 children (TUİK, 2022). In these cases, the custody of 75.7% of the children were given to the mother, and 24.3% were given to the father.

In Turkey, while civilian courts of first instance were in charge of divorce cases until 2003, these cases started to be handled by specialized courts with the Law on Family Courts numbered 4787. In the civilian courts of first instance, when a need arose, social workers, pedagogues, psychologists, or psychiatrists used to be appointed as experts (Nalbant, 2017). With the establishment of family courts, psychologists, social workers, and pedagogues have started to be employed within the court. Consequently, an opportunity has arisen to engage in interdisciplinary investigations and comprehensive inquiries concerning the challenges confronted by families and to create potential avenues for resolution. The assessment reports written by court-appointed experts yield considerable influence on important decisions affecting families, including matters pertaining to divorce, custody arrangements, and the establishment of personal relationships with the child. These reports are an important source in terms of identifying the problems experienced in families before and after the divorce.

Türkarslan (2007) argued that the potential for conflict and disharmony is natural in the family formed by two separate individuals. The disrupted family relations as a result of mismanagement of this potential may result in the couple's decision to get divorced. A divorce brings along both positive and negative outcomes for the child. The meaning that the parents attribute to divorce, their continuation of the conflict, and turning the process into a reckoning in the divorce process determine the size of the problems. Resolving intrafamilial conflicts, fostering a healthy single-parent family unit, improving relationships with the parent who has departed the familial residence, or separating the parent with problems from the family posing difficulties, hold the potential to engender favorable outcomes for children. However, many factors such as problems experienced in the divorce process, the effects of the extended family on the marriage union, personality characteristics of the parents, and their methods of problem-solving, communication, and anger management affect the divorce process and afterwards negatively.

Problems experienced in the family and divorce process lead to many problems in the children in the long and short term. In the beginning, children experience emotions such as confusion, sadness, distress, anxiety, fear, astonishment, and distrust, and following the divorce, they go through a crisis period that lasts at least two years (Kelly & Emery, 2003, Rogers, 2004). In this period, children are confronted with many changes, especially when

they are not adequately informed by their parents about separation and divorce, the uncertainties they experience force them more.

The issues on which the parents experience the most conflict in divorce cases are about who will have the custody of the child and how the personal relationship will be established with the separated parent. Custody and personal relationship can be reorganized even after divorce and until the child reaches the age of 18. Therefore, conflicts may continue for years, and the parties may file new lawsuits and carry their conflicts to a court of law.

Lampel (1996) states that in divorce and custody cases, parents may form an alliance with their child. As a result of this alliance, the child may refuse to see the targeted parent and develop unjust and hate-laden behaviors, emotions, and cognitions toward that parent. In contested divorce cases, by giving negative feedback to the child, parents may try to control the child's relationship with the other parent and turn the case to their favor by influencing the child's emotions and thoughts. Benedek and Brown (1997) underscore that when parents exhibit such orientations and form alliances, it may lead the child to cultivate negative sentiments and cognitive attitudes toward the parent who is the target of such behavior. Consequently, the child may abstain from engaging in any form of communication with that parent.

Conflicts experienced between parents and parents' negative attitudes toward each other can affect children's perception of the targeted parent (Mone & Biringen, 2012). One of the parents can guide the child negatively by denigrating the other parent with their words, behaviors, or attitudes (Kelly & Johnston, 2001). In such situations, the child may prefer one of the parents and refuse to establish a relationship with the other parent, may not want to see the parent and may not accept personal relationship arrangements established in the court process (Kayma Güneş, 2007; Koçyıldırım, 2010). The child alienated from the parent can completely cut his/her communication with the mother or the father for a long time and can exclude the mother or the father from his/her life. The child's growth by being deprived of the mother or the father and having strict and negative thoughts and emotions toward the parents is a situation that rather forces the child and threatens his/her healthy development (Benedek & Brown, 1997). The use of children as o tool for manipulation in the context of parental conflicts, the disparagement of one parent and/or their extended family, and the dissemination of inaccurate information to the child regarding that parent and their relatives can likewise be considered as instances of emotional abuse (Demirbaş, 2018; p. 165).

Wallerstein and Kelly (1976) have defined the child' rejection of a parent or not wanting to see the parent after divorce with the concept of pathological alienation. Later in the 1980s, based on his studies with the families in the divorce process and afterwards, Richard Gardner used the term "parental alienation syndrome" in order to explain the behaviors that emerge in the child as a result of one parent slandering the other parent in such contested divorce cases. Gardner (1985) defined PAS as one parent's brainwashing the child against the other parent consciously or unconsciously, the child's denigration of the parent, and alienation from the parent. Gardner states that "parental alienation" and "parental alienation syndrome" are not the same concepts. While parental alienation is a more general definition, parental alienation syndrome covers a situation that emerges in the determination process of the child's custody as a result of the child's being programmed by either the mother or the father.

Gardner (2002, 2002a) mentions eight primary symptoms of parental alienation. These are:

1. Denigration campaign against the targeted parent,

2. Guiding the child inro an inconsistent, irrational, weak, and nonsensical reasoning in order for him/her to reject the targeted parent,

3. Producing inconsistent statements, terms, and scenarios related to the child's life and developmental process,

4. Lack of the child's ambivalent emotions toward his/her parents,

5. The claim that the decision to refuse the targeted parent was made by the child,

6. The child's unconditional and automatic support of the alienating parent,

7. Absence of an evident feeling of guilt in the child,

8. Feelings of grudge and hatred spreading to the extended family of the targeted parent (Cartwright, 1993).

Gardner (2002) states that PAS has three levels, which are mild, moderate, and severe. In mild-level PAS, the alienating parent influences the child regarding her/his being a better parent through verbal and nonverbal ways. In this level, communication between the alienated parent and the child continues to exist. In the moderate-level PAS, in which the child displays destructive behaviors against the alienated parent, negative feelings such as anger and hatred toward the alienated parent develop in the child. The parent experiences difficulty in communicating with the child. In severe-level PAS, an intense level of alienation is exhibited. The child supports the slandering campaign of the alienating parent. In this level, no communication can be established between the child and the alienated parent.

Goldin and Salani (2020) examined the behaviors and attitudes of children exposed to PAS and determined the descriptors of PAS. Accordingly, in the process of high-conflict separation and divorce in children, the formation of a strong alliance with the alienating parent, alienation from the rejected parent, the use of the child as a tool to harm the targeted parent, the child's refusal to establish a relationship and spend time with the alienated parent without a legitimate reason, lack of ambivalent feelings, They emphasized the absence of guilt or remorse, the assertion that one's feelings, thoughts and attitudes toward the parent are not influenced by anyone else (independent thinker phenomenon), the presence of untrue stories, the child's unconditional and automatic support for the alienating parent, and the feeling of hostility toward the extended family of the rejected parent. Additional features included the presence of made up narratives, the child's unconditional and reflexive support for the alienating parent, and the propagation of animosity extending to the extended family members of the rejected parent. Maltreatment of the child by the rejected parent is not evaluated within the scope of PAS.

Baker and Fine (2008) state that 17 different alienation strategies are used in order to harm the relationship between the child and the targeted parent. These are badmouthing, limiting contact and interfering with communication, withdrawal of love, forcing the child to choose, telling the child that the targeted parent does not love him/her, creating doubt in the child, forcing the child to reject the targeted parent, telling the child that the targeted parent is dangerous, asking the child to spy on the targeted parent, creating suspicion in the child, asking the child to keep secrets from the targeted parent, referring to the targeted parent by his/her first name, alienating parent's introducing the potential new spouse as mother/father to the child, changing the name and surname of the

child, withholding medical, academic, and other important information of the child from the targeted parent, and cultivating dependency on the alienating parent. Another situation that is significant in the alienation process is that the child frequently uses words such as "we", "us", and "our" while narrating an event (Farkas, 2011). Torun (2017) points out that the extended family of the alienating parent also plays a role in the alienation process and provide significant support to the brainwashing campaign. As a result, the child is not only alienated from the targeted parent but also rejects to see his/her grandmother or grandfather and other relatives (Cartwright, 1993).

In the studies which conducted with families, parents expressed their claims of child abuse in order to get the custody of the child, that these claims were mostly unfounded and used to punish the targeted parent. In divorce, custody, or personal relationship cases, parents intentionally bring up child abuse allegations in order to restrict or completely eliminate the relationship of the targeted parent with the child (Gardner, 1999). Gardner (2002) states that the child's alienation from a parent who sexually, physically, or emotionally abuses the child is an expected situation, and in this case, PAS is not valid.

Children are negatively affected by the alienation behaviors they are exposed to and experience problems according to their age and developmental characteristics. It is seen that children exposed to such behaviors experience numerous psychosocial problems such as anger, sadness, disappointment, fear, low self-respect, bonding and separation anxiety, anxiety disorders, depression, sleep problems, eating and elimination problems, academic issues, and disrupted peer relations (Baker, 2005; Baker, 2006; Baker & Verrocchio, 2013; Lowenstein, 1998; Sher, 2015; Torun, 2017; Verrocchio, et al., 2019). These problems vary according to the severity and duration of PAS. Raso (2004) states that as the level of parental alienation increases, the child's internal and external problems become more serious, that these problems continue for years, and that they could reflect them onto their own children. In a study conducted by Vassiliou and Cartwright (2001), as the frequency of the visitation of the separated parent with the child increased, alienation was determined to have significantly decreased.

In Turkey, studies which examined divorce, custody, and personal relationship with the child cases, where parental alienation is experienced the most intensely, are limited. Erdoğan (2020) examined the reports prepared in custody cases, emphasized that the reports focused on allegations made about the targeted parents, and that emotional abuse applied to children could be ignored. He also stated that the custody of the child was not given to the targeted parents without making detailed evaluation regarding parental alienation.

In the study conducted by Yurdakul (2022), in which PAS was evaluated from the perspective of mothers, fathers, children, and social service experts, it was found that the alienated parent could not see the child after divorce, could not communicate with the child, and was encountered with the barrier created by the parent who had the custody of the child. It was also emphasized that the extended family exacerbated the severity of PAS, and that children accepted the authority of the mother and father of the parent who had the custody of the child. It was observed that children were exposed to degrading discourses of the parent they lived with about the other parent, and that they felt angry about the alienated parent. The most significant factor that affects children's psychology is being caught between two sides. In the study conducted by Ulutürk (2019) examining PAS and behavior problems in children, it was determined that behavioral and emotional problems were seen in children exposed to PAS. The

purpose of this study was to analyze PAS behaviors experienced in cases filed in family courts for divorce, custody, and arrangement of personal relationship with the child.

Method

Research Model

In the present study, one of the qualitative research methods, document/text analysis was used. In document/text analysis, printed material including the subject examined are screened in detail, and a new integrity of information is created from this information (Creswell, 2007; Yıldırım & Şimşek, 2016). In the present study, a descriptive analysis of the evaluation reports prepared by experts in divorce, custody, and personal relationship cases was performed.

Data Sources

The reports prepared by psychologists, social workers, and pedagogues (psychological counsellor), including the researcher, in the cases held by Ankara 10th Family Court were included in the study. PAS symptoms criteria (Gardner, 2002) and alienation strategies in the literature were considered. The reports were screened by the experts according to PAS behaviors, and the ones that fit Gardner's moderate and severe level PAS symptoms were selected. 27 files were chosen for the study. 9 of these files were divorce, 8 were custody, and 10 were the files of the cases opened for the arrangement of personal relationship with the child. The cases and the persons who opened the cases are presented in Table 1.

Table 1

Information about the cases opened

	Mother	Father	Grandmother/Grandfather
Divorce Case	5	4	
Custody Case	4	4	
Personal Relation Case	4	2	4

Table 2

Information about the mean age, education, and employment status of the mothers, fathers, and grandmothers/grandfathers

	Mother	Father	Grandmother/Grandfather
Mean Age	37	41	62
Education Status			
Illiterate			1
Primary School	7	6	5
Secondary School	2	3	2
High School	9	9	
University	9	9	
Work Status			
Employed	13	26	3
Unemployed	14		3
Retired			2

It was determined in the study that 38 children in total (16 girls and 22 boys) were interviewed, the average number of children of the families was 1.4, and the mean age of the children was 9 years.

Data Analysis

After the reports on divorce, custody, and personal relationship cases were determined, they were descriptively analyzed. It was determined that the data obtained in the descriptive analysis were collected under four themes. These themes include the following:

1. PAS behaviors aimed at parents

2. PAS behaviors aimed at relatives

3. PAS behaviors displayed by the parents in the court process

4. Behaviors seen in alienated children

In this context, statements extracted from the reports were determined as analysis units, and every sentence in the reports was read and presented with the themes created according to the responses given.

Results

Results of PAS behaviors aimed at the parents

As a result of the descriptive analysis of the reports, it was found that 6 mothers displayed PAS behaviors. It was also determined 16 mothers alienated their children from their fathers, while 4 mothers alienated the children from their grandmothers and grandfathers. Alienation behaviors started in the marriage union, continued in the court process and afterwards with increasing intensity, and were used to gain various advantages in the cases. Alienation behaviors of mothers, fathers, and relatives are presented in Table 3

Table 3

PAS behaviors of mothers, fathers, and relatives

	Mother	Father	Relative(M)	Relative(F)
The child' addressing the parents with words used by grown-ups such as that woman for the mother and that man for the father	9	5	10	7
Guiding the child by negatively speaking about the parent	14	7	14	7
Getting the child to witness events in the marriage union	10	7	11	7
Telling the child that alienated parent applies violence to the mother	8	2	8	2
Telling the child that the parent is cheating	5	3	8	3
By meeting all demands of the child to ensure s/he prefers him/her	9	7	14	7
Getting the child to spy on the separated parent	12	7	15	5
Withholding the child's information such as health, circumcision, school, etc.	9	6	10	3
Orientation that harms the relationship between the child and the parent	16	7	12	7
Getting the young child to call the grandmother as mother		4		4
Undermining the authority of the alienated parent over the child	13	7	16	5
Getting the child to take sides in the events between the mother and the father	11	5	14	6
The parent showing himself/herself as the victim and reflecting the need to be protected by the child	10	2	13	2
Allegations aimed at the alienated parent such as cheating, abandoning, etc.	11	6	9	6
Allegations that the alienated parent expose the child to neglect and abuse (verbal, physical, and sexual)	7	3	9	3
Not informing the child about the deceased father	4		4	
Getting the child to address the newly married man as father	2		2	

As seen in Table 3, it was determined that mothers, fathers, and relatives displayed alienation behaviors in order to influence the child such as badmouthing about the other party, slanders, getting them to witness events experienced, victimizing the self, and wanting the child to take sides. It was found that the children were made to call grandmothers or newly married individuals as mother or father instead of their biological mothers and fathers, and thus, it was aimed to get the children to forget their mothers and fathers. In addition, alienating parents claimed that the alienated parent applied physical, verbal, and sexual violence to the children, that they did not look after the children and neglected them. However, they did not display any behaviors so as to prove these allegations in the court process. The four personal relationship cases opened by grandmothers and grandfathers, the mothers did not give much information to their children about their fathers. In two of these cases, it was determined that the mothers had the child call the man they newly married as father, and the children knew the new spouse as their biological father.

Results of PAS behaviors aimed at relatives

Expert reports showed that in their PAS behaviors, mothers, fathers, and relatives targeted the relatives of the other party. It was determined that the parties reflected their hostile feelings regarding the relatives and blamed the relatives for the problems experienced in the marriage. Alienating behaviors aimed at relatives are presented in Table 4.

Table 4

PAS behaviors aimed at the relatives

	Mother	Father	Relative(M)	Relative(F)
Reflection of hostile feelings onto the relatives of the alienated parent	14	7	11	7
Negative expressions about grandmothers/fathers, aunts, etc.	16	5	16	5
Stating the problems experienced in the marriage were caused by relatives	13	4	17	7
Claiming that marriage union was disrupted by relatives	10	3	17	7
Claiming that relatives slander the parents	6	1	8	3
Not introducing the child with the mother and father of the deceased spouse	4		3	
Transmitting hostile thoughts and feelings about the relatives of the deceased spouse	4		3	

In the study, it was observed that mothers did not provide information about the mothers, fathers, and other relatives of their deceased spouses. In one of these cases, the mother confessed that she hid her address so that the grandparents could not find her, but she could not give a solid rationale for this behavior.

Results of PAS behaviors displayed by the parents during the case

When descriptive analysis was performed, it was seen that parental alienation was used in order to involve the child in the case process and to gain advantages. The parental alienation behaviors displayed by the parents are presented in Table 5.

Table 5

PAS behaviors in the case process

	Mother	Father	Relative(M)	Relative(F)
Applying pressure on the children to be preferred for custody	13	7	17	7
Bringing the children to the hearings and getting them to witness the problems experienced with the parent	9	4	10	3
Getting the children to read the case files or telling them about what happened in the hearings	8	6	4	4
Using the child in order to gain the upper hand in the case	12	4	8	4
Threatening the child that if s/he chooses the other side, s/he cannot see the other parent	8	6	12	5

As seen in the table, it was determined that in order to denigrate the targeted parent in the case process, children were brought to the hearings, they were made to read the case proceedings, parents applied pressure on the children to choose them and threatened the children that they would not see each other again if they choose the other parent.

Another issue encountered in the case process is related with the problems experienced in the personal relationship established between the child and the separated parent. In divorce, custody, and personal relationship cases, a personal relationship arrangement is made by considering the age of the child and the conditions of the separated parent. The reports showed that many PAS behaviors were displayed in order to restrict or prevent the child and the separated parent from seeing each other (Table 6).

Table 6

PAS behaviors displayed in the personal relationship established between the child and the separated parent in the cases

	Mother	Father	Relative (M)	Relative (F)
Demanding delivery of the child through enforcement	9	5	13	5
Intervening in who could be present during the delivery of the child	15	9	5	5
Applying pressure and violence to the other parent during the delivery of the child by having the relatives present	11	4	11	4
Trying to determine who could see the child.	13	5	16	6
Putting limits to the places where the child could be taken and the relatives	13	6	9	5
Having non-stop phone calls with the child on the days of personal relationship, thus interfering with the relationship	11	3	3	2
Asking the child to provide information about the separated parent	16	5	13	6
Not allowing any communication on the days other than personal relationship day	13	5	10	5
Not allowing to see the child in places such as school, course etc. other than personal relationship days	13	7	7	5
Making the child not want to go	11	5	11	5
On the days of personal relationship, not being at home and preventing the relationship with excuses such as illness, etc.	9	4	5	4
Making the child not want to go on personal relationship days by organizing various activities	9	4	7	4
Preventing the personal relationship and claiming that the separated parent did not want to come	8	3	11	3
Displaying a strict attitude regarding the receiving and delivery times of the child	13	7	5	4
Not showing the child to the mother, father, and relatives of the deceased spouse			4	3

As seen in Table 6, alienating parents wanted the personal relationship to be held with enforcement officers, they wanted to determine the people to be present during the delivery of the child, they brought their relatives during the reception of the child from the parent to make things difficult, and they tried to prevent personal relationships through various excuses. They did not obey court orders, they wanted to prevent the relationship between the separated parent and the child, they tried to prevent communication on the days other than personal relationship days, they interfered with the duration of the personal relationships, they did not want the separated parent to see the child in places such as school, course, etc., they forced the managers of such institutions in this regard, they tried to convince the child that the separated parents did not want to see him/her, and they were strict about the time of taking and bringing back the child home.

Results of the behaviors observed in the alienated children

Descriptive analyses of the interviews held with the children are presented in Table 3.5. It was seen that the children were prepared when they came for the interview, and that from the first moment on, they said they did not want to see their mother or father and tried to tell about the negative events which they claimed to have experienced. The children behaved in a fictitious way, that they went back to the beginning when a question conflicting the fiction was asked, and that they said "First of all, I want to tell that he beats my mother and applies violence to us" and wanted to finish what they aimed to tell quickly.

Table 7

Behaviors observed in the children exposed to PAS

	Child
Children narrated the events in a certain fiction	22
Their moods were not in parallel with the event while narrating it, they did not exhibit	30
any symptoms of anxiety, fear, or anger and acted in a relaxed way	23
They did not feel any regrets regarding the events about the separated parent	27
The language they used was not compatible with their developmental levels	23
They could not explain the events they narrated with concrete examples	28
They narrated exaggerated stories of the parent	33
While narrating the events, they used pronouns such as we, us, our	27
They said they themselves did not want to see the separated parent	38
Children's negative behaviors decreased and they wanted to continue the relationship when personal relationship was established with the separated parent under the supervision of an expert	16

When they enjoyed the time they spent with the separated parent, they avoided telling this to the parent they lived with	17
Although they wanted to take it, they tried not to take a gift from the separated parent	28
While the child was being taken from the parent s/he lived with under the supervision of and expert, s/he displayed exaggerated behaviors (crying, retching, screaming, etc.), but behaviors changed as they moved away from the house	8
In detailed interviews, they expressed that they wanted their parents to live together despite all negativities	10
They did not want to go to the house of the separated parent's family, and they expressed negative thoughts and feelings about them	27

The children narrated the events told by their parents as if they experienced or witnessed them. However, it was observed that their moods did not match the events they narrated and they could not give concrete examples. The children copied what their parents told them, that the language they used was not compatible with their developmental periods, that they indicated that they themselves did not want to see the separated parent, that they did not feel any guilt regarding the separated parent, that when they spent good time with their parent during personal relationship time, they hesitated to tell about this to the parent they lived with, and that they did not want to get the gifts given by the separated parent.

Analyzing of ten reports showed that visitations were organized under the supervision of an expert in order to observe the relationship between the children and their separated parent and to re-establish the relationship between the children and the separated parents who did not see each other for a long time. It was observed that while the children were taken from the home of the parent s/he lived with and delivered to the separated parent, they exhibited exaggerated behaviors such as crying, retching, and screaming and yelling. It was also observed that such behaviors disappeared as they were moved away from the house. In the relationship between the parent and the child organized under the supervision of an expert, a certain improvement was achieved in a short time, and the child' attitude toward seeing the parent softened. In studies conducted in this framework, the personal relationship between the child and the separated parent could be maintained with some consensus in 8 cases. However, it was also found that the relationships did not improve in most of the cases and that conflicts continued to exist in the case process and its aftermath. Considering the problems experienced, five parents were sent for psychiatric evaluation. In addition, it was determined in the reports that interlocutory injunction against the families were ordered, and in this context, 23 parents were directed to the institutions to get counselling about child education, communication, and child raising (within the framework of Article 6/c Protective and Preventive Social Precautions of Family Courts Law). Family counselling was recommended to 5 mothers and fathers. In addition, the court experts indicated that following psychiatric evaluations and family counselling, custody and personal relationship should be re-evaluated. However, it was determined that the families did not receive such counselling, and the courts did not apply any sanctions in this

regard. In the descriptive analyses, it was also found that attention was drawn to custody and personal relationship abuses, and it was reported that custodies should be restored.

Discussion, Conclusion & Suggestions

Detailed reports prepared by appointed psychologists, social workers, and pedagogues in courts are an important source of information in determining intrafamily problems, conflicts, and problems experienced in the parent-child relationship. In this study, the reports prepared in a total of 27 divorce, custody and personal relationship cases with the child were examined. The expert reports examined in this study. It was found that PAS was applied by the mothers the most. While he expressed in his early studies that PAS was applied by women the most, Gardner (2001, 2002) later stated that both parents applied it. In a study conducted by Machuca (2005), it was determined that tendency toward alienation was higher in women compared to men. It was also found that mothers exhibited more alienation behaviors in comparison to fathers (Altuntaş & Ziyalar, 2018; Baker & Darnell, 2006; Erdoğan, 2020). Mothers and fathers, first degree relatives such as grandfathers, grandmothers, aunts, etc. were effective in alienation behaviors. It is thought that this situation is a result of the continuation of extended family relations in the Turkish family structure, importance and closeness of relative relationships, the high effect of first degree relatives in marriage rituals, and the inability of the spouses to put a limit to these relationships in the marriage union and divorce process. Women may have to live dependently on their families in the period after the divorce due to experiencing economic and social problems. This situation may cause the relatives to be more easily involved in the divorce process. In the study conducted by Aktaş Akoğlu and Küçükkaragöz (2018) on the reasons of divorce and problems experienced in its aftermath, factors such as economic distress, difficulty to move to a separate house, and involvement of the relatives in the problems were found to be effective. In light of this information, it would be significant to research how the first degree relatives affect PAS process.

In the descriptive analyses, it was determined that the parents and relatives expressed degrading words about the other parent in order to influence the child, got the child to witness the problems experienced, showed themselves as the victims, and wanted the child to take sides. Another significant finding regarding alienation behaviors was that children were made to call grandparents or newly married persons as mother or father instead of their biological mother and father and to forget the targeted mother or father. Moreover, it was found that it was claimed that the alienated parent applied physical and sexual violence to the child, but that there were no behaviors in the court process in order to prove such allegations.

Slanders such as cheating, abandoning, violence, child abuse aimed at the alienated parent, telling the child that the cause of the divorce is the alienated parent, the child's ascribing inappropriate nicknames to the mother or father, getting the child to witness events, and influencing the child by meeting his/her excessive demands are some of the examples of alienation behaviors displayed. It was also found that a perception that the alienating parent was victimized and needed the protection of the child was created in the child. These findings are consistent with Gardner's (1999, 2001,2002) eight primary PAS symptoms. Gardner (1999, 2002) stated that parents claim that the targeted parent maltreats the child in order to get the custody of the child, that these were mostly unfounded and were used to punish the targeted parent.

It was determined that the behavior styles of mothers, fathers, and relatives that cause PAS to develop involved Baker and Fine's (2008) alienation strategies that are used in harming the relationship of the child with the targeted parent. Similar to Baker and Fine's (2008) alienation strategies, it was found that the parents displayed alienation behaviors such as badmouthing, restricting, preventing, and totally cutting off communication, withdrawal of love, forcing the child to choose, claiming that the targeted parent did not want the child, getting the child to reject the targeted parent, claiming that the targeted parent was dangerous, the alienating parent's introducing the new spouse as mother/father to the child, and withholding the child's medical, academic, and other important information from the targeted parent. Not allowing to visit the child at the school, not sharing the child's information about education, and trying to get the managers and teachers to take sides in this process were also among the alienation behaviors. In the literature, it has been stated that behaviors such as denigration campaign against the targeted parent, influencing the child, forcing the child to choose, telling the child that the separated parent does not want to see him/her, and trying to gain advantage in the hearings are displayed (Baker & Darnall, 2006; Erdoğan, 2020; Waldron & Joanis, 1996). The findings obtained in the present study support the results of these studies.

In this study, it was determined that one of the Gardner's (2002) eight PAS criteria, negative emotions, thoughts, and guidance aimed at relatives were performed. It was seen that hostile feelings toward the first degree relatives of the targeted parent were induced in the child, the child's communication with them was restricted or cut off, and it was claimed that the cause of the problems experienced in the marriage and divorce was the relatives. These findings are consistent with the alienation behaviors aimed at relatives such as slanders, not allowing the child to see the relatives, and hostile attitudes found in the literature (Baker & Darnall, 2006; Baker & Fine, 2008; Waldron & Joanis, 1996).

It was found that PAS behaviors displayed by mothers, fathers, and relatives intensified more in the case process. It was seen that children were brought to the hearings in order to denigrate the targeted parent, they were made to read the case proceedings, pressure was applied on children to choose them in the determination of the custody, and children were threatened that s/he would not see them if s/he chose the other parent. These findings are similar to the findings obtained in PAS research such as the study by Şen (2014) on parents with divorce experience, the study by Yurdakul (2022) with the field experts, and the study by Ulutürk (2019) on divorced and unseparated parents. All these findings support Gardner's (1985) view that parents display PAS behaviors in order to gain advantage in the court cases.

It was also determined that another problem encountered in the case process was related with the personal relationships established between the child and the separated parent. When the expert evaluation reports were descriptively analyzed, many PAS behaviors that aimed to restrict or prevent the child from seeing the separated parent were determined. It was found that in the divorce, custody, and personal relationship cases, problems were created regarding the establishment of personal relationship between the child and the separated parent, they tried to get the child through enforcement, the child was forced to not want to leave, parents tried to control with whom, where, and how personal relationship would be established, and personal relationship was tried to be prevented or the process was interfered with. The finding of this study that the relationship between the child and the separated parent

was harmed in the case process supports the study results in the literature. It has been stated that such alienation attempts by parents could cause the child to develop hostile thoughts and feelings against the targeted parent (Mone & Biringen, 2012), and to refuse to maintain all types of communication (Benedek & Brown, 1997).

Conflicts experienced between parents and the negative attitudes of the parents toward each other can affect the perceptions of children regarding that parent and cause the child to sever his/her relations with the parent and grow being deprived of that parent (Benedek & Brown, 1997; Kelly & Johnston 2001; Mone & Bringen, 2012). Negative behaviors aimed at the targeted parent in the court process can cause the child to refuse to establish a relationship with the parent, not to want to see him/her, and not to accept the personal relationship arrangement (Kayma Güneş, 2007; Koçyıldırım, 2010). The alienated child may cut his/her communication with the mother or father and remove the targeted parent totally from his/her life. This situation forces the child psychologically and traumatizes him/her. Researchers have reported that alienated child's problems continue for years and they transfer these problems to their own children (Raso, 2004).

In addition to the psychosocial consequences of preventing the child's relationship with his/her parent, it is seen that the child's right to establish a relationship with his/her parents and relatives protected by national and international regulations was denied and their rights were abused. European Contract on the Establishment of Personal Relationship with the Child emphasizes the importance of maintaining the personal relationship of the child with his/her parents and relatives. The contract stipulates that personal relationship cannot be restricted unless the child's best interest necessitates it, and that in potential conflicts, necessary mediations should be made and other measures should be taken. In addition, the European Convention on the Exercise of Children's Rights recommends that the child should be represented by a separate counsellor at court in the case where the child's rights could not be protected by the parents due to various conflicts of interest. It is believed that in such cases, considering the best interest of the child, it would be useful for the child to be represented by a counsel other than the parents.

One of the issues that was emphasized in this study was the reactions of the children exposed to PAS behaviors. It was observed that the children were prepared while coming to the hearings, they narrated the events in a certain fiction, they did not display any fear, anxiety, sadness, or anger symptoms while narrating the events, the language they used in narrating the events did not match the developmental stage they were in, especially in younger children, they could not support their words with concrete examples, and they exhibited anger and anxiety when they could not narrate the events as they wished. It was determined that the children used exaggerated expressions, they used pronouns such as we and us, they insisted that they themselves preferred not to see the targeted parent, their behaviors changed in the visitations held with experts, they were confused, and they felt guilty about the good times spent with the separated parent. These findings overlap with the behaviors in alienated children determined by Gardner (2001, 2002), Baker and Darnall, (2006), and Waldron and Joanis (1996). The children's use of pronouns such as we and us while narrating the events supports the findings of Farkas (2011).

It is thought that PAS behaviors which they are exposed to negatively affect children's psychosocial development. It has been emphasized in the literature that in children exposed to PAS, emotional and behavioral problems are experienced (Johnston et al., 2005; Ulutürk, 2019), and they display low self-confidence, addiction,

smoking and alcohol use, and risky sexual behaviors (Kruk, 2018), lack of self-confidence and social anxiety (Baker, 2005), low self-esteem, sleep disorders, anxiety, and depression (Baker & Ben-Ami, 2011; Baker & Verrocchio 2013; Lowenstein, 1998, Sher, 2015; Torun, 2017; Verrocchio et al., 2019).

In light of all findings obtained in this study, it is seen that PAS behaviors harm the relationship established between the child and the parents and relatives, and that the child is negatively affected in the process. Therefore, the issue must be handled in detail by the experts and judges in the case process. In cases where parental alienation is not recognized, the alienating parent can affect case processes (Erdoğan, 2020; Torun, 2017). Lowenstein (1998) argues that the allegations against the alienated parents should be investigated in detail.

PAS is a type of emotional abuse. In this study, it was seen that there were physical and sexual abuse claims. Gardner (2002) states that such behaviors may emerge, in which case the child's alienation from the parent can be expected. Therefore, it is a must that court experts be informed and aware of PAS in order to distinguish PAS from physical, sexual, and other abuses. In terms of protecting the child and the family, it is important that experts who evaluate the case should be knowledgeable about parental alienation and these situations should be evaluated regarding the arrangements to be made for the child. It is important for court professionals to know that PAS behavior is an abuse of custody and of the personal relationship with the child. As a result, it is thought that, if necessary, custody and personal relationship with the child decisions can be changed in favor of the alienated parent.

In this study, it was seen that some families were directed toward psychiatric evaluation, child education, counselling on child raising, and family counselling. It was, however, determined that families did not obey these orders. Lack of sanctions by the court in this regard causes families to maintain their arbitrary behaviors regarding the solution of the problems.

Suggestions

-Families and their children are confronted with serious problems in the case process and afterwards. Systematic psychosocial services should be developed for families and their children.

-The study findings showed that academic information of children was withheld from the separated parent. In this context, it is important in terms of preemptive works that in addition to court experts, school psychological guidance experts should be informed about PAS.

-In Turkey, there are studies on PAS in the form of compilation studies and case presentations. However, court reports in which problems experienced in cases such as divorce, custody, etc. are evaluated provide detailed information about PAS. Hence, more research on PAS is needed.

-In order to understand the process better, the effect of the relatives in the development of PAS behaviors should also be analyzed.

 -Increase in the number of studies on PAS will serve to the diversification and applicability of the programs to be developed. It is believed that the current study will contribute substantial insights to the existing body of literature.

Ethic

In this study, scientific, ethical and citation rules were followed; It has been committed that no falsification has been made on the collected data, and that all responsibility belongs to the authors for all ethical violations to be encountered.

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Developing the Digital Competencies of Instructors in the Process of Distance Education

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Abstract

The general purpose of this study is to improve the digital competencies of the instructors in distance education through a professional development program. It was also intended to identify the efficiency of the professional development program designed and implemented with regards to this general purpose. An embedded mixed design, one of the mixed research models, was used. The participants in the research are the instructors working in all faculties, colleges and vocational schools in a public university. In the research, a needs analysis was conducted initially to determine the areas in which instructors need the most support in distance education. In this context, a professional development program regarding "Course Design in Distance Education" and "Web 2.0 Tools and Application Samples" was prepared for the instructors. This professional development program was implemented and evaluated. As a result of this process, it was determined that the majority of the instructors needed training on Web 2.0 tools and applications, instructional design in distance education, and methods and techniques appropriate for distance education. It was concluded that the professional development program prepared in line with the needs analysis conducted within the scope of the research had a positive effect on the self-efficacy perceptions of the instructors towards distance education. In the research, suggestions were made to increase the quality of the teaching service during the distance education process.

Key Words

Distance education • Digital competencies • Instructors

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Recent technological advances have led to significant opportunities for the introduction of technological tools to the learning-instruction processes, and these technological applications have become compulsory due to the emergency distance education conducted during the pandemic. The concept of emergency distance education refers to the temporary transition of teaching, which is normally conducted face-to-face, online or blended, to alternative options due to crisis situations (Ferri, et al., 2020). Distance education can also be described as a systematic educational process that increases the equality of opportunity for those who could not attend face-to-face education, and is not limited by time or space, employs technologies and mass media to support education (Moore, & Kearsly, 2005), and allows two-way communications (Clark, & Mayer, 2016). During the pandemic, since all formal education institutions from primary to higher education completely switched to distance education, learning and instruction had to be conducted online (Ahlawat, et al., 2020) and so higher education institutions had to adopt radical changes to introduce distance education systems (Bozkurt et al., 2020). While these applications were adopted to continue education in the early days of the pandemic (Cutri, et al., 2020), it required the revision of instruction and learning environments after this process, too (Henriksen, et al., 2020). Can (2020) also argued that our approach to education evolved into a mixed model where face-to-face and distance education would also be employed after the pandemic, in other words, mixed education practices would be adopted in the following days. Similarly, Karadağ and Yücel (2020) reported that new global educational paradigms would emerge after the pandemic. Thus, distance education has become a significant factor in current educational approaches due to technological advances and pandemic.

The pandemic situation has further accelerated the digital transformation in educational activities (Nebot et al., 2021) and it has forced educators to rapidly develop the digital competencies required for distance education (do Espírito Santo et al., 2022). Not only the pandemic, but also the fact that The 21st century's understanding of education has been shaped by digital communication tools, the changing characteristics, needs and demands of new generation students who want to have an interactive and participatory active learning experience supported by technological tools (McLoughlin, & Lee, 2010). In the standards published by the International Society for Technology in Education (ISTE), which emphasize the characteristics of effective instructors, it is especially emphasized that instructors should support the learning process with technology and it is stated as a necessity for them to use both face-to-face and online environments effectively (ISTE, 2008). Instructors play a key role in distance education courses because they are the initial users of the distance education environment, who instruct the students in this process (Mitchell et al., 2015). Since education is increasingly becoming a digital and online world with a range of new technologies (Goh, & Sandars, 2019), the instructors in distance education are required to design effective instruction for adaptation of face-to-face courses into distance education (Iwai, 2020).

In the distance education process, instructors are expected to clearly determine course objectives, balance synchronous and asynchronous activities in instructional design, encourage students to work in groups, produce different content, provide effective feedback, and employ digital tools and materials at all stages. In other words, success in distance education depends on the awareness of educators about these new roles and the development of their competencies in these roles (Kır, 2020). It is stated that distance education can yield successful results only if instructors conduct good design and implementation (Maurer, & Davidson, 1998; Özonur et al., 2019). However, in

this process the current situation of instructors related to the interest, attitude, perception, motivation and self-efficacy towards technology (Ertmer, 2005; Palak & Walls, 2009), and the properties of instructors regarding technology can affect this process (Kenny, 2003; Wejnert, 2002). When the literature is reviewed, there are some studies reporting that instructors have problems with technology and technology-supported applications (Ashrafzadeh, & Sayadian, 2015; Bingimlas, 2009; Curir et al, 2010; Çalışkan et al., 2012; Ertmer, & Ottenbreit-Leftwich, 2010; Kyei-Blankson et al., 2009; Özüdoğru, & Çakır, 2014; Sadi, et. al, 2008; Venkatesh et al., 2016) and their level of utilizing technology is low (Agyei, & Voogt, 2011; Bate, 2010; Gao et al., 2011). Besides, there are also studies encountered in literature which investigate the digital competencies of instructors working in various universities (Dervenis, et al., 2022; Doğan, 2023; Gökbulut et al., 2021; Jorge-Vázquez et al., 2021; Nebot et al., 2021; Sánchez-Caballé, & Esteve-Mon, 2022; Santos et al., 2021) resulting that the instructors need to develop their digital competencies.

Furthermore, in the related literature, there are some studies concluding that instructors need training on issues such as content development in distance education, use of the system and ensuring interaction (Bilgiç et al., 2011; Bozkurt, 2020; Erkut, 2020; Gürer et al., 2016; Karadağ, & Yücel, 2020). Also, there are studies which identified that instructors were incompetent in distance education requirements and emphasized the importance of training instructors in terms of the adoption and effectiveness of distance education (Can, 2020; Düzakın, & Yalçınkaya, 2008; Hark-Söylemez, 2020; Kayaduman, & Demirel, 2019; Yıldız, 2015). In addition, it was reported that educators were not competent in online education digital technologies, and regular in-service training should be provided for instructors (Ak et al., 2021). Erkut (2020) also emphasizes the need for instructors to undergo serious training and restructure their courses in accordance with online environments in order to provide online education effectively in distance education process. Furthermore, Karadağ and Yücel (2020) studied the satisfaction of undergraduate students with online education in Turkey during the pandemic and reported that the students were not at all satisfied with the preparation and instruction of the digital content and employment of instructional material by the instructors. Bilgiç, Doğan, and Seferoğlu (2011) argued that orientation training should be provided for the instructors for more effective distance education, which in turn could contribute significantly to the effectiveness of the system. Within the light of all the aforementioned studies, it was contemplated that the instructors were not effective enough in digital or technological issues on distance education. Therefore, the general purpose of this study was to improve the digital competencies of the instructors in distance education through a professional development program. It was also intended to identify the efficiency of the professional development program designed and implemented with regards to this general purpose. By means of the impelemented professional development program, it was expected to improve the quality of the instruction in the universities by supporting the instructors to design effective teaching process in distance education. Therefore, the following research questions were searched throughout this study:

• What are the needs of the instructors in distance education learning and instruction processes?

• Is there a significant difference between self-efficacy pre-test and post-test perceptions regarding distance education?

• Are the instructors satisfied with the designed and implemented professional development program?

• What are the views of the instructors regarding the professional development program?

Method

Research Design

The present study was conducted with the embedded mixed design. It was reported that mixed method was superior to approaches that employ a single design approach since it allows series of confirmatory and exploratory questions concurrently due to the employment of both quantitative and qualitative methods, provides stronger inferences and variety of views (Teddlie, & Tashakkori, 2009). The embedded mixed design is a comprehensive mixed method approach where quantitative or qualitative data are analyzed simultaneously (Greene, 2007; Mazlum, & Mazlum, 2017). In the embedded mixed design, the dataset allows for a secondary auxiliary function. Researchers embed a qualitative study into a quantitative experiment to achieve an empirical design (Creswell et al., 2009). The most common form of the embedded design is the incorporation of additional datasets within a larger design to answer different research questions. The most typical example is the embedded experiment format, where the researcher incorporates qualitative data into the experiment. In the embedded design, researchers should incorporate qualitative data when answering the secondary research question in a primarily quantitative study (Creswell, 2014; Creswell, & Plano Clark, 2011). In the present study, the embedded experiment form was preferred, and the quantitative and qualitative data were employed to support each other. Gall, Gall, and Borg (2010) reported that the employment of both quantitative and qualitative methods was effective in confirming the validity of the findings. Thus, the quantitative dimension of the study was designed with the quasi-experimental design, and the qualitative dimension was designed as a case study that supported the quantitative dimension.

Participants

Study participants included the faculty members in all faculties, colleges and vocational schools in a public university. In the needs analysis and the pre-interview stage, the study participants included 102 instructors in Education, Science and Literature, Engineering, Forestry, Theology, Economics and Administrative Sciences, and Health Sciences, the School of Physical Education and Sports, and vocational schools. In the professional development program applied in the study, and the pre- and post-tests applied before and after the program, in other words, in the quantitative dimension of the study, the study participants included 53 instructors employed in the above-mentioned faculties and colleges. The participants demographics for both the experimental and quantitative dimensions of the study are presented in Table 1.

Table 1.

Descriptive Characteristics of the Participants for the Quantitative Dimension of the Study

Variables	Categories	f	%
Gender	1. Female	22	41.51
	2. Male	31	58.49
Working Department	1. Faculty of Education	10	18.87
	2. Faculty of Arts and Sciences	7	13.21
	3. Faculty of Engineering	3	5.66
	4. Faculty of Forestry	6	11.32
	5. Faculty of Religious Studies	4	7.55
	6. Faculty of Economics and Administrative Sciences	5	9.43
	7. Faculty of Health Sciences	6	11.32
	8. School of Physical Education and Sports	4	7.55
	9. Vocational Schools	8	15.09
Title	1. Prof. Dr.	7	13.21
	2. Assoc. Prof.	12	22.64
	3. Asst. Prof.	19	35.85
	4. Lecturer	9	16.98
	5. Research Assistant	6	11.32
	Total	53	100

The maximum variation sampling method was employed to determine the participants in the final interviews conducted after the application. Maximum diversity was preferred to determine whether there were any common or shared phenomena across diverse cases and to determine diverse dimensions of the problem (Yıldırım, & Şimşek, 2013). Thus, 10 volunteering participants employed in various departments were assigned among the instructors who participated in the professional development program, and demographics of these participants are presented in Table 2.

Table 2.

Descriptive Characteristics of the Participants for the Quantitative Dimension of the Study

Participant	Gender	Title
P1	Female	Prof. Dr.
P2	Male	Asst. Prof.
P3	Male	Lecturer
P4	Female	Assoc. Prof.
P5	Male	Prof. Dr.
P6	Male	Research Assistant
P7	Female	Lecturer
P8	Female	Asst. Prof.
P9	Male	Assoc. Prof.
P10	Female	Research Assistant

Application

Initially, a needs analysis was conducted to determine instructor requirements in distance education. The interviews conducted with the instructors were designed both to serve the needs analysis and as preliminary interviews. The preliminary interviews conducted for the needs analysis revealed that the instructors mostly felt incompetent in instructional design in distance education and effective use of digital tools. Thus, a professional development program was developed by the authors. "Course Design in Distance Education" and "Web 2.0 Tools and Applications" courses were developed for the participating instructors. These courses included interactive synchronous and asynchronous applications and examples that would allow the instructors to design effective online courses and conducted on the LMS system. "Distance Education Self-efficacy Scale" and semi-structured interview form were applied as a pre-test before the instruction of the professional development program. After the instruction, the scale, semi-structured interview form and a training satisfaction survey were applied. The professional development program content is presented in Figure 1.

Figure 1.

Content of the Professional Development Program

Basic Concepts in Distance Education	• Distance Education, Online Education, Online Instruction, Blended Learning, Flipped Learning
The Process of Designing Online Instruction	• Community of Inquiry Model, ADDIE Modeli, Universal Design for Learning (UDL), Understanding by Design (UbD), Characteristics of a well-preapred design
Steps of Instructional Design in Distance Education	• Determining the purpose of the course, Writing the achievements, Dividing the achievements into modules, Deciding on the module model, Determining/designing the activities (Synchronous-Asynchronous), Deciding on the LMS and integrating the design into the LMS, Implementation, Evaluation, Moving on to the next module
Learning and Content Management (LMS and CMS) Instruments	• Google Classroom, Canvas, Beyaz Pano, Edmodo, Moodle
Introductory (Warm-up) Activity Tools	• Mentimeter, Wooclap, Padlet, Quiziz, Kahoot, Socrative, Flipgrid
Course Lecturing Tools (Digital Visual and Content Preparation Tools)	• Effective Presentation Preparation Tools (Canva, Emaze, Nearpod, Buncee, Prezi) • Poster, Banner, Infographic Preparation Tools (Canva, Easelly, Genially, PostermyWall, Piktochart) • Video-Animation Preparation Tools (Powtoon, Animatoo) • Concept Map-Mind Map Preparation Tools (Mindmeister, MindMup, Bubbl.us, Popplet, Cacoo) • Interactive Video Production Tools (Edpuzzle, Playposit) • Interactive Reading Tools (Perusal, Hypothesis)
Collaborative Working Tools	• Padlet, Seesaw, Mindmeister, RiseupPad,Whiteboard.fi, Jamboard (collaborative whiteboard), Jigsawexplorer (Collaborative Puzzle)
Process Evaluation Tools	• Quiziz, Kahoot, Quizlet Quizmaker, Socrative, Wordwall, Flipgrid, Puzzlemaker
Alternative Tools	• Educandy, Storyjumper, Evernote, Matific, Wheel of Names, Emoji-maker

Data Collection Instruments

During the research, both quantitative and qualitative data collection instruments were employed before and after the experimental application. The quantitative study data were collected with the "Distance Education Self-Efficacy Perception Scale" developed by Yıldız (2015). The scale included 10 five-point Likert-type items in three sub-dimensions: learning management, technology management and virtual classroom management. The reliability coefficients were .83, .78 and .82 for these sub-dimensions, respectively, and .86 for the whole scale (Yıldız, 2015). In the present study, the Cronbach Alpha reliability coefficient was.86 for learning management, .82 for technology management, .85 for virtual classroom management, and .89 for the whole scale. Also, a Satisfaction Survey was applied to determine the satisfaction of the instructors with the professional development program. The 22-item survey included questions on the duration of the program, the time reserved for each content, the adequacy of the content, the instructional quality of the content, the clarity of the content and the instructor-participant interaction sub-dimensions. The Cronbach Alpha reliability coefficient was .88 for the survey items in the study.

A semi-structured interview form was developed by the authors to collect the qualitative study data. The semi-structured interview form developed for preliminary interviews and needs analysis included six questions, and the final interview form included five questions. Draft interview form was submitted for the review of three experts and interview forms were revised based on expert opinion. Also, a pilot scheme was conducted with two instructors with the interview form. Probing questions were added to the interview form based on participant responses in the pilot scheme, and the form was finalized.

Data Analysis

The quantitative study data was analyzed with SPSS 22 software. The pre-test and post-test scores of the instructors in the Distance Education Self-Efficacy Perception Scale were compared with the Wilcoxon signed ranks test. Descriptive statistics (arithmetic mean, standard deviation) were employed to analyze Satisfaction Survey scores. On the other hand, content analysis was employed to analyze the interview data before and after the application. Content analysis aims to categorize similar data based on certain concepts and themes to achieve comprehensible interpretation of the data (Yıldırım, & Şimşek, 2013). Maxqda qualitative data analysis software was used in data analysis. A code was defined for each research question by the authors on the Maxqda software, and participant responses were analyzed word by word and sentence by sentence to determine the codes and themes. The reliability formula (Agreement / Agreement + Disagreement) developed by Miles and Huberman (1994) was employed to determine the reliability of the analyzes. The reliability coefficient was calculated as .91. The themes determined during the analysis and the correlations between the themes are presented in the findings section. Furthermore, the sample participant statements for these themes are included in the findings section.

Results

Needs Analysis and Preliminary Interview Findings

The needs analysis and preliminary interview data collected from 102 instructors are presented in this section. The results of the analysis of the participant participants' responses to the question on whether they have participated in any previous professional development program on distance education are presented in Table 3.

Table 3.

Participation in the Professional Development Program on Distance Education

Categories	N	%
Yes (I have participated in a professional development program)	37	36
No (I haven't participated in a professional development program)	65	64
Total	102	100

As seen in Table 3, 64% (N=65) of the instructors did not participate in any professional development program on distance education, while 36% (N=37) stated that they have participated in a professional development program on distance education.

In the needs anaylsis part of the study, the instructors were asked about their incompetence and requirements in online instruction and training. The participants were able to chhose more than one option in this question, and the results of their responses are given in Table 4.

Table 4.

Subject Areas Instructors Required Training for Distance Education

Categories	N	%
Web 2.0 Tools and Applications	55	54
Instructional Design in Distance Education	49	48
Distance Education Methods and Techniques	46	45
Measurement and Evaluation in Distance Education	19	19
Use of Learning Management System (LMS)	11	11
Total	102	100

As seen in Table 4, 54% (N=55) of the instructors reported that they required training on Web 2.0 tools and applications, 48% (N=49) required training on instructional design in distance education, and 45% (N=46) required training on distance education methods and techniques. Furthermore, according to instructors' expressions, 19% (N=19) of them required training on online measurement and evaluation, and 11% (N=11) required training on learning management systems (LMS).

The analysis results on the responses to the question on how the participants instructed distance education courses are presented in Table 5. The instructors were able to choose more than one option in this part of the needs analysis, as well.

Table 5.

Instructional Approach in Distance Education Adopted by Instructors

Categories	N	%
Non-Interactive Synchronous Approach	68	67
Interactive Synchronous Approach	36	35
Non-Interactive Asynchronous Approach	24	24
Interactive Asynchronous Approach	9	8
Total	102	100

As seen in Table 5, 67% (N=68) of the instructors stated that they instructed online courses with the non-interactive synchronous approach, and 35% (N=36) stated that they preferred the interactive synchronous approach. Also, 24% (N=24) stated that they designed their courses with the non-interactive asynchronous approach, while only 8% of the instructors (N=9) reported that they adopted interactive asynchronous approach in their courses.

Furthermore, the instructors were asked two questions on the design of the learning and instruction processes, the instructional methods and digital tools and platforms they utilized for the design of online courses, and the analysis results of their responses are presented in Figures 2 and 3. 2% (N=3) of the instructors were research assistants and did not respond to these practice-based questions since they did not actively instruct any courses.

Figure 2.

Methods and Techniques Used in Distance Education by Instructors
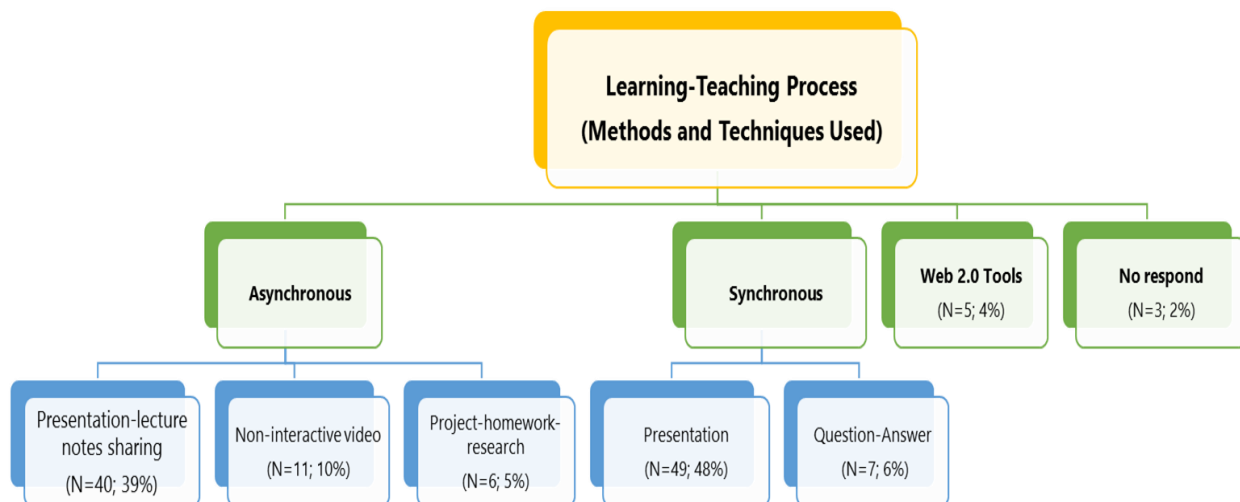
As seen in Figure 2, the instructors mostly employed synchronous instruction methods in online education. Among the synchronous methods and techniques, 48% of the participants stated that they preferred the presentation method (N=49), and 6% preferred the question-answer method (N=7). Furthermore, 39% (N=40) of them reported that they shared presentations and lecture notes asynchronously on the LMS system, 10% (N=11) used non-interactive videos, and a few of them (5%; N=6) applied projects, homework, and research assignments. Besides, only 4% of the participants (N=5) stated that they employed Web 2.0 tools in distance education.

Figure 3.

Digital Tools and Platforms Used in Distance Education by Instructors
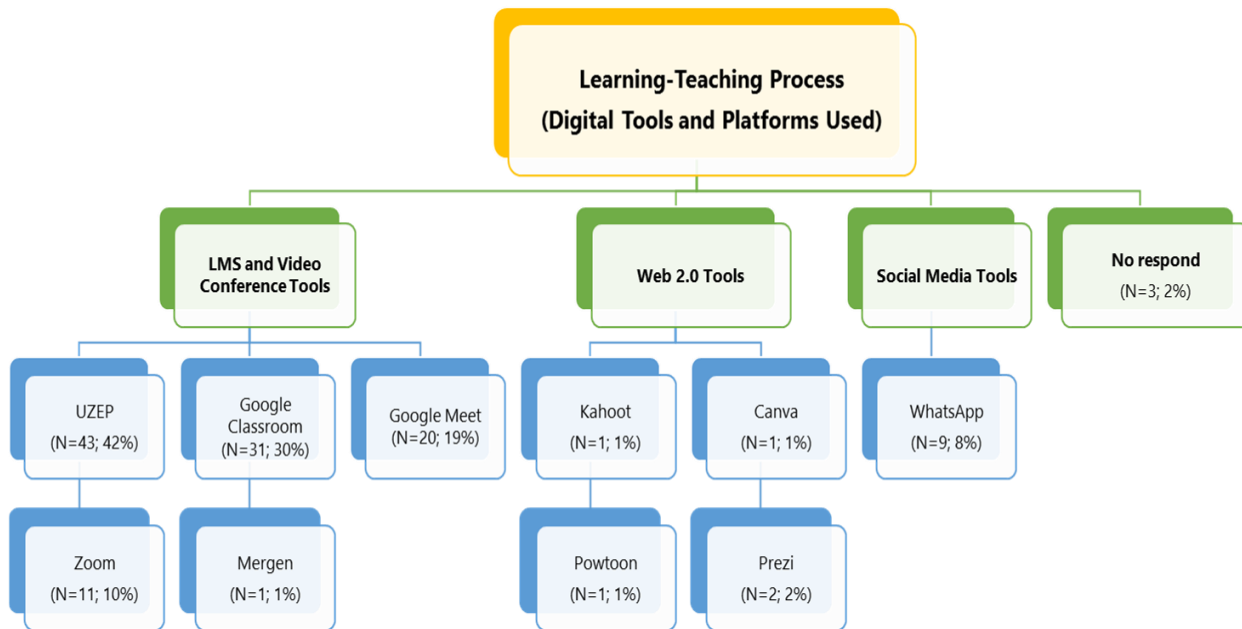
As seen in Figure 3, the instructors frequently employed LMS and video conferencing tools in distance education. Thus, 42% (N=43) of the instructors stated that they employed the UZEP (distance education system) system of their institution, 30% (N=31) used Google Classroom, 19% (N=20) employed Google Meet, 10% (N=11) used Zoom, and 1% (N=1) employed Mergen. Furthermore, 8% (N=9) of them reported that they used WhatsApp as an effective social media tool to communicate and share documents with the students. Also, it was observed that the number of instructors who employed web 2.0 tools in learning-instruction processes was quite low (N=5, 4%). 2% (N=2) of the instructors used Prezi to prepare presentations, 1% (N=1) used Kahoot, 1% (N=1) used Canva to determine course material, and 1% (N). =1) used the Powtoon application to develop video and animations. Certain instructor statements on the methods and techniques, and digital tools and platforms they employed in distance education are presented below.

I6: "In synchronous courses, I delivered lectures during the first half-hour of the class using presentations, and then I used questions and answers. After the synchronous class, I uploaded related links and files to the UZEP system."

I23: "I used conventional tools such as presentations, document sharing. I shared these on Google Classroom."

I28: "I instructed synchronous courses. I shared various materials such as lecture notes, presentations and study questions on the covered topics on the UZEP system, I also developed Google Classroom classes for each course. The materials were also shared there."

I47: " I applied the same method we use in traditional classroom education during one-on-one synchronous classes on Google Meet for presentations, and I asynchronously shared the resources on UZEP ."

I53: " I utilized multimedia sites for various content types, including videos, pictures, and audio. I created engaging animations using Powtoon and converted them into videos."

I71: "I downloaded videos for students, sometimes I created videos and shared them on WhatsApp. In synchronous classes, I employed the question-and-answer method based on the videos. Even though I don't think it is an effective asynchronous method, I shared my lecture notes with the students on UZEP."

I96: "Before each class, I uploaded posters and infographics I created using Canva to Google Classroom. During synchronous classes on Zoom to enhance interaction, I conducted instruction using presentations I designed on Prezi. I then shared these presentations with the students after the class. While I followed this procedure, I also wished to incorporate additional digital tools to further enhance the effectiveness of my instruction ."

The analysis results for instructor responses to the question on the measurement and evaluation approaches they adopted to measure the efficacy of online courses and the measurement and evaluation tools and materials they employed are presented in Figure 4.

Figure 4.

Measurement and Evaluation Approaches and Tools Adoped in Distance Education by Instructors
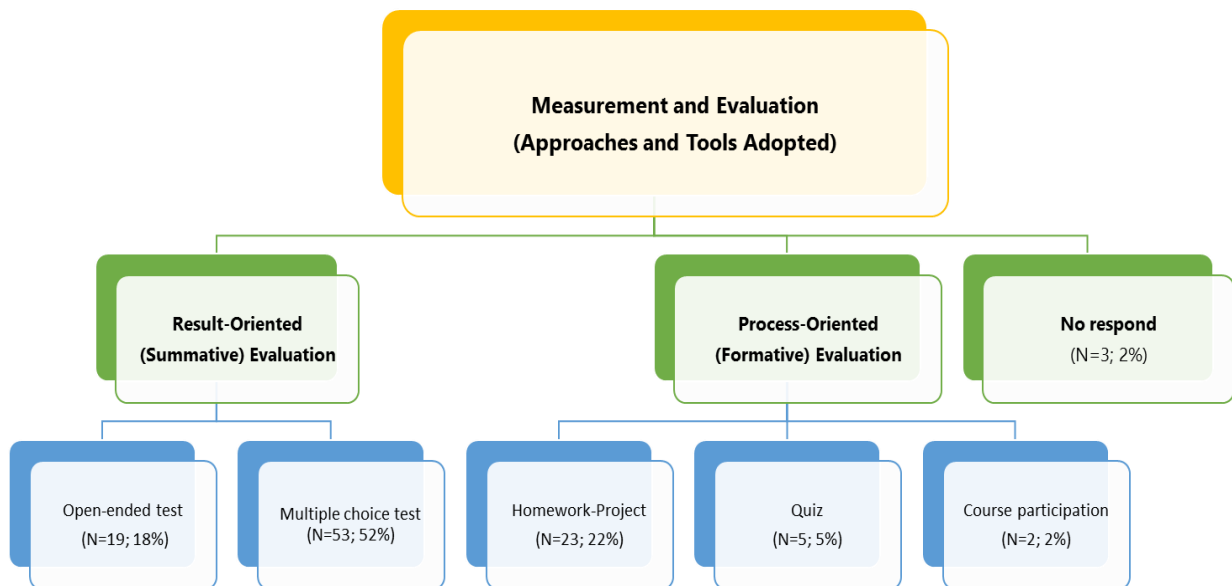
As seen in Figure 4, the instructors mostly adopted the result-oriented (summative) evaluation approach (N=72, 71%) in measurement and evaluation in distance education. It was determined that 52% (N=53) of the instructors who evaluated the results employed multiple-choice tests and 18% (N=19) employed open-ended questions. Moreover, 29% (N=30) of them focused on process-oriented (formative) evaluation. Among these instructors, 22% (N=23) assigned homework and projects, 5% (N=5) conducted quizzes at various intervals, and 2% (N=2) based their evaluation on course participation. Certain instructor statements on the measurement and evaluation methods, the tools and equipment they adopted in distance education are presented below.

I29: "I preferred different types of questions (multiple-choice and open-ended questions) especially during face-to-face education and employed open-ended questions in the exams during distance education. Especially in the quizzes, the same topics or the same questions were asked to the students using different types of questions to allow them better to comprehend the topics. However, the biggest problem was that some of the students did not participate in these applications or talked with each other."

I39: "I preferred the 20-question tests similar to the face-to-face education. But I changed my scale of 2 minutes per question to 1 minute per question. I added 2-3 minutes to the total test period if there were long sentences in the course, especially during the finals and make-up exams. I also collated the questions and the order of the answers. Thus, I reduced the probability of cheating in distance education."

I73: "I used to evaluate both homework and exams in face-to-face classes, but I evaluated only weekly homework assignments in distance education."

I82: "I had to exclude in-class evaluations during distance education. I had to measure and evaluate based on open-ended and interpretation-based questions on UZEP."

Application Findings

The findings collected with the Distance Education Self-Efficacy Perception Scale, applied before and after the professional development program developed based on the needs analysis and preliminary interviews conducted with the instructors are presented in Table 3.

Table 6.

Distance Education Self-Efficacy Perception Scale Pre-Test and Post-Test Scores

Pretest-Posttest	N	Mean Rank (MR)	Total Rank	Z	p
Negative Rank	0	.00	.00	6.34	.00
Positive Rank	53	27.00	1431.00		
Equal	0				

As seen in Table 6, a significant difference was obtained between the mean ranks of pretest and posttest applications of Distance Education Self-Efficacy Scale scores (Z=6.34; p<.05). The significant difference was in favor of the positive ranks, in other words, the post-test mean rank (SO=27.00). Thus, it could be suggested that the

professional development program had a positive impact on the self-efficacy perceptions of instructors in distance education.

In addition, the satisfaction survey was applied to instructors at the end of the professional development program in order to determine the satisfaction level of them. The related findings are presented in Table 7.

Table 7.

The Satisfaction of the Instructors with the Professional Development Program

Sub-dimension	N	X	S
Application duration	53	4.51	0.70
Content/duration ratio	53	4.47	0.69
Relevance of the content	53	4.64	0.59
Instructive quality of the content	53	4.66	0.52
Comprehensibility of the content	53	4.62	0.56
Instructor- participant interaction	53	4.77	0.42
General satisfaction	53	4.61	0.45

As seen Table 7, the general satisfaction of the instructors with the professional development program after the application was found to be quite high (X=4.61, S=0.45). Based on the views of the instructors, the sub-dimension with the highest satisfaction was the instructor-participant interaction sub-dimension (X=4.77, S=0.42). This sub-dimension was respectively followed by the instructive quality of the content (X=4.66, S=0.52), relevance of the content (X=4.64, S=0.59), and the comprehensibility of the content (X=4.62, S=0.56). The sub-dimensions that the instructors were less satisfied with were the content-duration ratio (X=4.47, S=0.69), and the application duration (X=4.51, S=0.70) sub-dimensions.

Final Interview Findings

In the final interviews conducted with the instructors, questions about their expectations from the professional development program and whether these expectations were met were asked, and the analysis of the responses is presented in Figures 5 and 6.

Figure 5.

Expectations of Instructors from the Professional Development Program
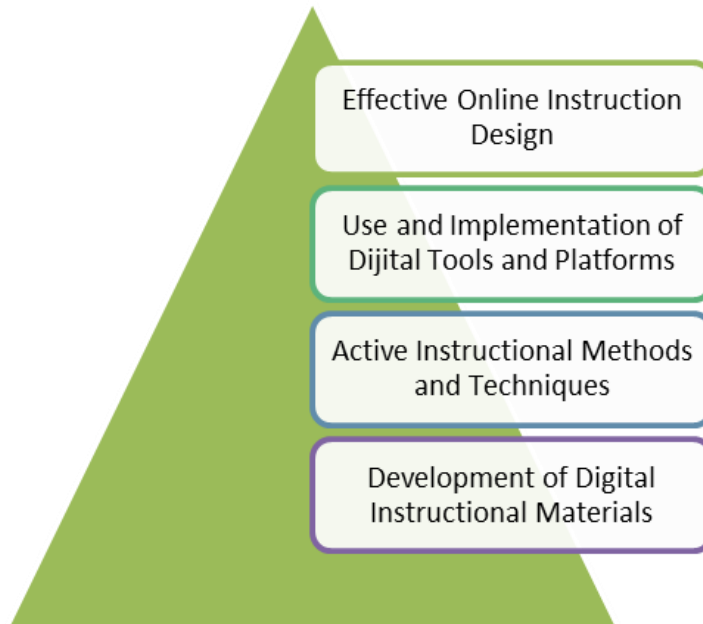
Figure 6.

Status of the Professional Development Program Meeting Expectations
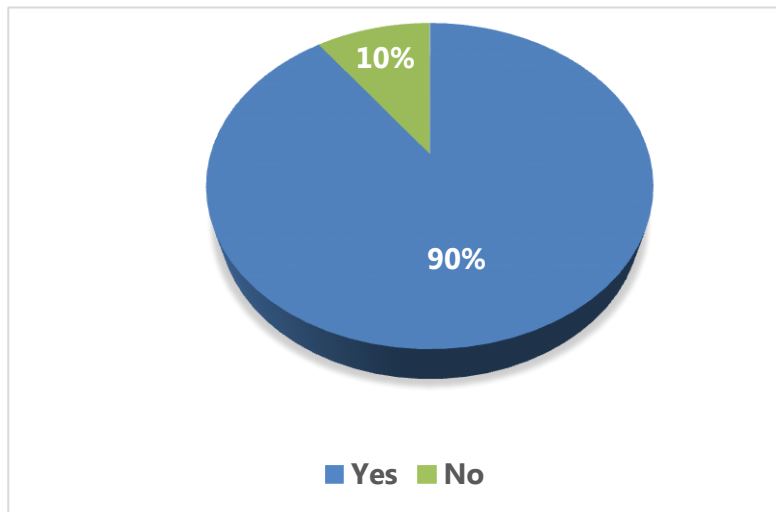
In the final interviews conducted with the instructors, the instructors stated that they had expectations such as instruction on effective online instruction design, implementation of digital tools and platforms, active instructional methods and techniques, and development of digital instructional materials from the professional development program. For the question whether these expectations were met, 90% of the instructors (N=9) stated that the

professional development program significantly met their expectations, while 10% (N=1) responded that it did not fulfill their expectations due to the limited implementation period. Certain instructor views on their expectations from the professional development program and the fulfillment of these expectations are presented below.

P1: "Under current conditions, distance education is more valuable than before. I have been always interested in distance education applications and I tried to follow the developments as much as I can. As soon as I heard that the experts planned such a training, I completed the registration procedures and attended all the courses. During the training, I execrated to improve my knowledge and acquire new knowledge. The training exceeded my expectations. During the training, presentation of the applications for online courses in the form of concrete examples was very valuable."

P5: "In this training, I expected to improve my proficiency in course development and presentations based on course objectives and achievements using digital instruction material in distance education. These expectations were more than met."

P8: "My expectation from the training was to acquire skills to develop effective instruction materials with various digital tools and design my classes with these materials. In the training, I learned where and how I can use various tools, but it could have been much better if we could have practiced. I know that a much longer training should be organized for achieve this, so my expectations were not met due to the time limit."

P10: "Especially in online classes, my expectation was to acquire the ability to diversify my classes with various Web 2.0 tools to encourage student participation, to improve their interest, motivation, and to instruct permanent knowledge. The training exceeded my expectations."

Furthermore, the instructors were asked whether they implemented any changes in their instructional design and whether they employed these instructional designs after the professional development program, and the analysis results of their responses are presented in Figures 7 and 8.

Figure 7.

Status of the Instructors Making Changes in Their Instructional Designs

Status of Instructors Making Changes in Their Instructional Designs

I made changes.
(N=3; 30%)

I am planning to make changes.
(N=5; 50%)

I have not made any changes yet.
(N=2; 20%)
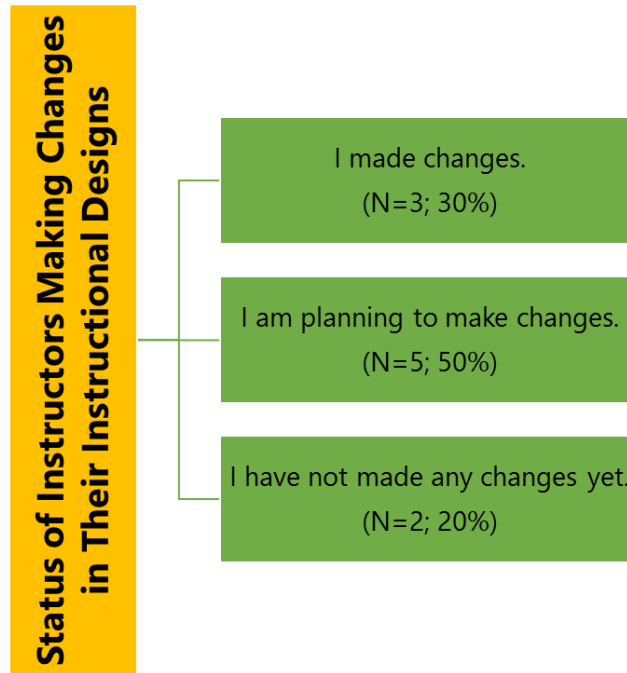
As seen in Figure 7, 30% (N=3) of the instructors stated that they changed their instructional designs after the professional development program, and 50% (N=5) stated that they planned to make changes. On the other hand, 20% of the instructors (N=2) stated that they did not change their instructional design methods.

Figure 8.

Status of the Instructors Implementing Their Instructional Designs

Status of Instructors Implementing Their Instructional Designs

Implementing instructional designs
(N=4; 40%)

Working on instructional designs
(N=6; 60%)
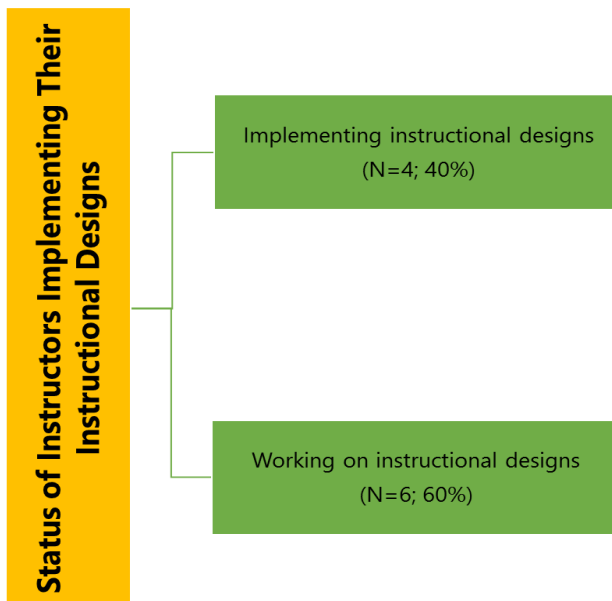
As seen in Figure 8, 40% (N=4) of the instructors reported that developed and started to implement a new instructional design. Besides, 60% (N=6) of them stated that they started to redesign their instructional approach based on the professional development program and they were working on their instructional designs. They stated that they revised their instruction based on what they learned in the program, and they will redesign their courses. Certain instructor statements regarding the implementations and works on their instructional designs are presented below.

P2: "Yes, I did. I revised the content and allowed more interaction in the learning process. I included Web 2.0 tools in the process. I included homework assignments and peer assessment in evaluation."

P4: "I haven't had a chance to make any changes in my courses, but I will redesign my courses."

P6: "After the training, I had the idea to implement changes, but I have not done it yet. But I plan to use different instruction approaches and different tools in my classes, and I will redesign my courses accordingly."

P9: "Yes, I can say that I completely changed the instructional design. I started to use Web 2.0 tools more, and I think that I now design and implement more effective courses."

Finally, the instructors were asked about the digital tools and platforms they used, learned to use, and could use in their classes, and the results of the analysis of their responses are presented in Figure 9.

Figure 9.

Digital Tools and Platforms Used/Learned by Instructors

As seen in Figure 9, 40% (N=4) of the instructors stated that they learned Edmodo, Canva, Padlet, Prezi, Kahoot, Bubbl.us applications during the professional development program applied and employed these in their classes. Also, 30% (N=3) stated that they started using Powtoon, Wordwall, Mentimeter, Edpuzzle, MindMeister applications, and 20% (N=2) stated that they started using Socrative, Nearpod, Flipgrid applications in their classes after the training. Besides, 10% of the instructors (N=1) reported that they learned Perusall, Phet, Thinglink, Quiziz applications during the professional development program and started to use these tools in their instructional designs.

P4: "I knew some of the tools but I never used them. Edmodo, Padlet, Powtoon, Edpuzzle, Bubbl.us, MindMeister and Mentimeter were introduced in the program and I started using these. When I saw what I could do with these tools, I started using them in my classes."

P5: "You introduced dozens of Web 2.0 tools in the program. I noted the tools I intended to use during the program. These were Prezi and Canva to prepare presentations, Kahoot and Quiziz for interactive evaluation, and I started using Edmodo in synchronous and asynchronous lectures. These will increase with future training."

P8: "I learned Web 2.0 tools such as Mentimeter, Nearpod, Padlet, Phet, Powtoon, Socrative, Thinglink, and Wordwall. I started to design my course with these tools."

After the professional development program developed and implemented for the instructors, the participants started to redesign, and others started to design their instructional processes and integrate digital tools and platforms further. Thus, based on instructor views, it could be suggested that the professional development program contributed to the development and implementation of effective instructional designs.

Discussion, Conclusion & Suggestions

The needs analysis and preliminary interviews conducted in the present study, which aimed to improve the digital competencies of the instructors in distance education, revealed that most instructors never participated in any professional development program on distance education. Tuncer and Tanaş (2011) reported that instructors did not participate in any distance education training program in their institutions. When the instructors were asked about their problems in distance education competencies and their training requirements, most instructors stated that they required training on Web 2.0 tools and applications, online instructional design, and distance education methods and techniques. Literature review revealed that since the transition to distance education was sudden during the pandemic, the instructors were not ready for this transition and experienced problems in distance education system and the design of online instruction practices (Durak et al., 2020; Kalloo et al., 2020; Marelli et al., 2021; Telli, & Altun, 2020). Öztürk (2020) reported that the instructors felt inadequate in the instruction of online courses. It was also determined in the present study that the instructors mostly preferred synchronous methods in online course design. In other words, only a few instructors adopted asynchronous approach in distance education, and these did not go beyond sharing lecture notes and presentations. Thus, it was determined that the instructors mostly preferred conventional instructional methods, even in distance education. Also, it was observed that the interactions between students and between students and the instructor were quite limited in both synchronous and asynchronous instruction. This could be due to the problems that instructors experienced in the adoption of interactive digital tools and platforms. The low number of digital platforms and devices that instructors employed before the professional development program was consistent with this finding. Sayan (2020) reported that instructors mostly instructed their courses with synchronous methods. Since today's technologies enable the creation of synchronous or asynchronous learning networks is an important advantage that technology has added to distance education (Beldarrain, 2006) and the employment of both synchronous and asynchronous applications in distance education could lead to a more effective learning environment (Balıkçıoğlu et al., 2019), the fact that instructors preferred synchronous applications could have led to a less active instruction environment. In a previous study, it was determined that instructors adopted both synchronous and asynchronous applications in online courses during the pandemic (Kurnaz & Serçemeli, 2020).

The analysis of the views on distance education and related practices of the lecturers before the professional development program demonstrated that most instructors had negative views and low self-efficacy perceptions about distance education. This could be attributed to a lack of competencies in distance education or the abrupt transition to distance learning during the pandemic. Literature review revealed similar findings. Certain studies concluded that instructor views on distance education were mostly negative, and they preferred face-to-face education (Dolmacı, & Dolmacı, 2020; Sayan, 2020; Telli & Altun, 2020). However, distance education applications are increasingly

prioritized in universities (Duman, 2020), and distance education applications intensified after the pandemic. Thus, distance education process could become more functional with the employment of digital learning and new technologies and systems (Telli, & Altun, 2020).

It was emphasized that in-service training for faculty members and educators, development of effective digital content, adoption of adequate online education methods and techniques, improvement of interaction in the instruction, and expert support are important to improve the efficacy of distance education (Erfidan, 2019) since distance learning requires careful planning and design (Bozkurt & Sharma, 2020). However, based on the present and previous study findings, it was determined that instructors' digital competency levels were low, and they needed to acquire these skills to improve the effectiveness of distance education. Telli and Altun (2020) reported that online educators experienced problems in the employment of technological tools and programs and required improvement. Bozkurt (2020) concluded that certain educators did not have adequate digital skills. Ferri, Grifoni, and Guzzo (2020) found that there were technological, pedagogical, and social problems in distance education in their study on the advantages and disadvantages of distance education during the pandemic. They emphasized that the digital skills of the educators were inadequate, and this was the leading pedagogical problem in distance education. Similarly, Karadağ and Yücel (2020) concluded that technological skills of the instructors were inadequate. Sayan (2020) also reported that the instructors were not proficient in the design and use of digital materials. Also, Kalloo, Mitchell, and Kamalodeen (2020) reported that the readiness of the instructors was inadequate for distance education during the pandemic and the instructors had to focus on different problems such as the development of adequate content for distance education and the employment of digital tools. In this sense, the application of the professional development program developed to improve the low self-efficacy perceptions of the instructors about distance education and to improve their digital skills led to relatively positive results. It was determined that the pre-test mean score and the total self-efficacy perception rank increased significantly after the professional development program. It could be suggested that the program topics such as "Online Course Design" and "Web 2.0 Tools and Applications" had a significant effect on the self-efficacy perceptions of the instructors in distance education. In the study conducted by Ak, Gökdaş, Öksüz and Torun (2021), was determined that the online in service training program had a significant effect on instructors' self-efficacy perceptions and perceptions of benefit for distance education (Ak et al., 2021).

It was considered significant that most instructors changed or planned to change their instruction design after the professional development program. Furthermore, it was determined that the number of digital tools and platforms learned and employed by the instructors increased after the application. Given the necessity of using technology in distance education and learning (Bilgiç & Tüzün, 2015), it can be inferred that the incorporation of digital tools and platforms by instructors will contribute to enhancing the learning environment in distance education, leading to more effective and productive instruction. As reported by Grout and Houlden (2014), technology use is essential in educational environments and technology use would improve learning efficacy.

In the study, it was determined that the instructors were quite satisfied with the program content, duration, comprehensibility, application, interactive and instructive properties. The expectations of the participants before the professional development program were highly met by the program. Barış and Çankaya (2016) emphasized that it

was quite important to support teaching staff with professional development and in-service training programs. Furthermore, they reported that feedback and implementation of the required changes and planning would improve the quality of distance education. Thus, all potential areas of educational improvement should be determined and related in-service training should be provided for the instructors for effective online education. Consistent with scientific and technological advances, instructors' online education skills should be improved. Thus, applied in-service training should be provided based on instructor requirements for effective and productive instruction. This study is limited with the instructors articipating in the research, the scope and activities of the professional development program designed and implemented by the researchers, and the findings and comments reached as a result of the analysis of the quantitative and qualitative data obtained in line with the data collection tools used by the researchers. In this regard, it may be suggested to conduct similar applied research with sample groups of different levels and sizes. In addition, professional development programs can be designed and implemented on this issue or different subjects that instructors need. The effectiveness of these programs should be analyzed to assist the employment of methods, techniques, digital tools and materials that would lead to a more participatory and active learning environment both in face-to-face and distance education.

Ethic

Author Contributions

This article was written with the joint contributions of two authors.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Investigation of Human Brain in the Relationship between Entrepreneurship and Economic Growth

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Abstract

One of the most basic assumptions of economics is that human beings are rational. The field of economics refers to this hypothetical human type as "*Homo Economicus*". Thus, the behavioral and psychological characteristics of the human factor in mainstream economics have not found much study area. However, thanks to the fields of behavioral economics, experimental economics, and neuroeconomics that have developed in recent years, it has begun to be investigated in economics literature with the help of other disciplines, especially psychology, too. Along with these studies, the structure of the brain has met with economics, especially neuroeconomics, in studies conducted after the 2000s. However, most of these studies have primarily focused on microeconomic analysis. Macroeconomic issues related to the brain have been addressed only to a limited extent in the economics literature. The aim of the study is to contribute to the literature by establishing a relationship between the brain and economic growth. In the study, the relationship between the human brain and economic growth is discussed on the basis of the concept of entrepreneurship. While evaluating the concept of entrepreneurship, studies on the right brain, which is the creative and innovative side of the brain, have been examined. As a result of the study, it was concluded that individuals who is right-brain dominant and use this lobe effectively will be successful entrepreneurs and thus contribute to economic growth. In addition, recommendations for the development of the right brain and the identification and support of potential right-brain dominant entrepreneurs are presented as a result of the review.

Key Words

Human brain • Economic growth • Right brain • Right brain training • Neuroeconomics • Holistic brain model

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Introduction

According to economic theory, the entrepreneur serves as both one of the factors of production, the one who brings these factors together. In economics, human beings are referred to as entrepreneurs in discussions of production factors, consumers in consumption theory, labor in production theory, policy makers in decision-making, investors in financial markets, and taxpayers when fulfilling their tax duties. They may even be considered free-riders when benefiting from public goods/services for free. Although these examples can be multiplied and the role of human changes within the economic structure, humans are consistently assumed to be rational in mainstream economic theory. The concept of "Homo Economicus", which assumes human rationality, is believed to facilitate economic analysis but also limits economists in their understanding of human behavior. Recently, the fields of behavioral economics and experimental economics have increased the interest of economists in behavioral sciences. With the development of neuroeconomics after the 2000s, economists have begun to examine the human nervous system and brain, thanks to the contributions of various disciplines. Considering that humankind's fascination with the brain dates back to ancient times, the intersection between the brain and the economy is relatively new. However, these new studies primarily fall within the realm of microeconomics. While studies on the human brain in the field of microeconomics, aided by various disciplines, continue to gain momentum and popularity, the relationship between economic growth and the human brain is not a topic frequently discussed in the economics literature.

In this study, the relationship between the brain and economic growth will be discussed within the framework of entrepreneurship. The connection between entrepreneurship and and the brain will be examined in terms of creativity and innovation, which are crucial characteristics of successful entrepreneurs. While explaining the concepts of creativity and innovation, these two terms are considered as a whole.

The main purpose of the study is to explore the connection between the human brain and entrepreneurship, particularly in relation to economic growth. The study has uncovered evidence linking the right brain to economic growth and offers suggestions for enhancing economic development through the cultivation and efficient utilization of the right brain.

The study is organized in four titles. Following the introduction, the relationship between entrepreneurship and economic growth. The third section delves into the structure of the brain, while the fourth section reviews the existing literature in this field. The study concludes with a final section for conclusions and evaluation.

1. The Relationship between Entrepreneurship and Economic Growth

When we examine developing countries grappling with resource scarcity, entrepreneurship emerges as a vital avenue for their economic and social advancement. Entrepreneurship represents a bold initiative, offering not only a path to economic growth but also the freedom to carve one's unique journey while challenging global stereotypes. From a historical perspective, entrepreneurship acted as an intermediary, actively assuming risks through agreements with capital owners during earlier eras. In the MiddleAges and the 17th century, entrepreneurs were the individuals responsible for planning and overseeing substantial projects such as public buildings, religious structures, and defensive fortifications, often without exposing state resources to risk. The transition to the Industrial Age in the

18th century saw entrepreneurs distinguished from contemporary real or legal entities providing risk-capital. In the 19th century, inventions and innovations increased in the light of successive technological developments, and the belief that the entrepreneur was "*the person at the key point of the economy and a catalyst of economic change and development*" was established. With Schumpeter, the creative and destructive effect of entrepreneurship has gained widespread influence since the 19th century, and the understanding of "replacing the actually existing products, processes, ideas and businesses with better ones (Tunç, 2007)" has dominated. With Schumpeter, entrepreneurship has been characterized as a God-given power that can be possessed by the extraordinary, and is at the forefront of innovation. Entrepreneurs, on the other hand, are people who meet possible and current demands and needs through innovation, activate businesses, which are the main catalysts of economic life, increase their capacities (or cause them to be closed by taking decisions in the opposite direction), and take risks with the aim of profit. Like an author who opens a book and engulfs his reader when they read the first sentences, entrepreneurs are leaders who will follow their qualified audience with a vision that is achievable and shares it. They are people who combine their resources and time while designing their future, take calculated risks, and choose their teammates meticulously. With the aim of increasing their quality of life day by day, they run to the big picture without stopping. Entrepreneurs, who do not neglect to benefit from technology and gaining knowledge, meticulously examine the research and publication reports made to analyze the market as well as their observations in order to realize their dreams and make their success sustainable (Kalfaoğlu, 2022).

Entrepreneurship is defined in Oxford English Dictionary in 1902 as "activity, behavior, or attitudes characteristic of an entrepreneur or entrepreneurs" (OED, 2023). Entrepreneurship has been dealt with in different dimensions later on and many definitions have been made. Although it is difficult to give a single definition of entrepreneurship, innovation and creativity are the most emphasized elements among these definitions (Çevik, 2006).

As with the definition of entrepreneurship, different definitions have been made for the entrepreneur by many authors. However, according to Aidis (2003), Schumpeter made the most important contribution to the definition of entrepreneurship with his book The Theory of Economic Development (1912). In his book, Schumpeter defined the entrepreneur as an innovative and leading individual. Thanks to imitative entrepreneurs who following the innovative leader, the economy is booming.

Entrepreneurship and the decision-making processes of entrepreneurs have gained significant attention in the economics literature. However, developments in behavioral economics necessitate a reevaluation of entrepreneurship's impact on economic and structural development. In this regard, Schumpeter's views contain a rich source (Santarelli & Pesciarelli, 1990).

According to Schumpeter (1947), the creative response in the business world also moves in parallel with entrepreneurship, which is the main driver of economic change in capitalist formations. The entrepreneur and the function of entrepreneurship can be defined as: "*doing new things or doing things in a new way that are already being done (innovation)*" (p.152).

The most important data in measuring economic performance and creating economic development is the increase in Gross Domestic Product (GDP) (Akcan & Metin, 2018). However, economic growth has a far-reaching impact on

many aspects of life (Akcan & Azazi, 2022). It can be argued that entrepreneurship bolsters economic growth through innovation and creativity. While the connections between entrepreneurship, creativity, innovation, and economic growth have not seen significant enrichment in economic theory since Schumpeter, psychology literature offers a more comprehensive perspective. In this regard, the psychology literature is more extensive, and there is a need to integrate psychological research with economic theory (Williams, 1983). Following Williams' insight, fields like behavioral economics, experimental economics, and neuroeconomics have emerged, allowing economists to explore human behavior, the human brain, and nervous structure through interdisciplinary approaches. However, the economics literature has dealt with the concept of rational human being intensively in this field and has conducted tests to falsify the rationality assumption. Macroeconomic issues such as economic growth, on the other hand, have been dealt with very limitedly.

However, for Schumpeter, the innovative and leading entrepreneur is too valuable to be confined solely to the realm of rationality or even to the debate about whether they are rational. This leads us to a critical question: How innovative or creative can a rational human be when freed from emotions? Innovative entrepreneurs are at the core of the innovation that drives economic growth. This question raises another question: How can we determine if Homo economicus possesses innovativeness? In the next parts of the study, the question of whether the human typology defined by the mainstream economics is an innovative individual will be tried to be explained by considering the structure of the human brain.

2. Structure of the Brain

The human nervous system, comprising nerve cells, subsidiary cells, and connections between these cells, constitutes one of the most complex biological structure. The central nervous system, responsible for control, resides in the brain (Canan & Sezen, 2018). The brain carries out this control function through billions of nerve cells, known as neurons (Pelvig et al., 2008). Neurons are the basic unit of work and the brain is shaped by the structure and function of neurons. There are billions (possibly up to a trillion) of neurons in the brain responsible for transmitting information to other nerve cells, muscle, and gland cells. Neuron consist of a nucleus and a cell body, with an axon extending into small axons. Synapses serve as communication points between neurons, while dendrites extend from the neuron's cell body to carry messages from neighboring neurons. Neurons transmit electrical impulses through their axons. Insulating myelin sheaths, on the other hand, increase the speed of this electrical conduction by covering the axon (Ariniello et al., 2002).
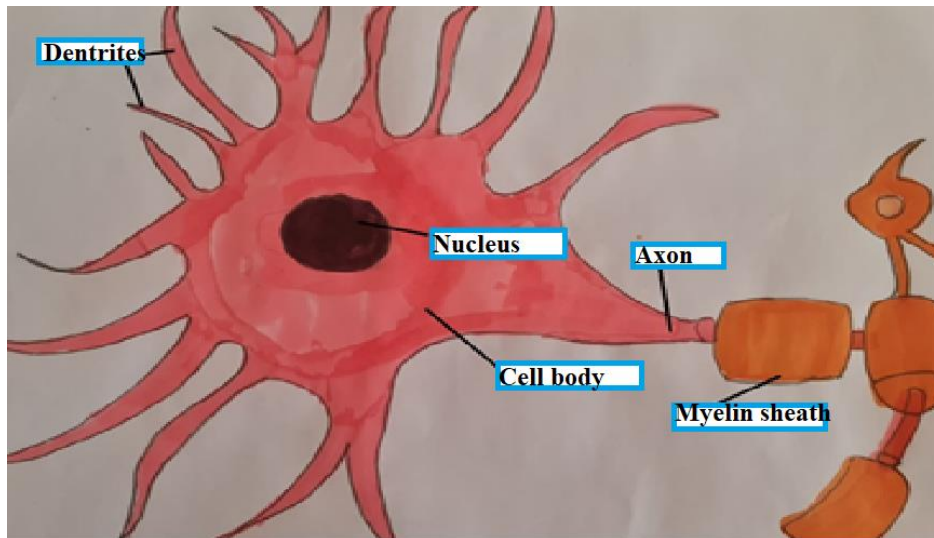
Figure 1. Structure of Neurons (Ariniello et al., 2002)

The brain consists of two hemispheres connected by a structure called the corpus callosum, facilitating communication between the two hemispheres. The hemispheres are covered by a layer known as the cerebral cortex, which envelops the entire brain with its distinct gray color. The cortex is divided into sections such as the occipital (occipital lobe), parietal (lateral lobe), temporal (temporal lobe), and frontal (frontal lobe) lobes. Below the cerebral cortex lie nuclear structures such as the hypothalamus, thalamus, and amygdala. Situated behind the brain stem is the cerebellum, which serves as a connection between the brain and the spinal cord. The brain is connected to the body's organs through axon connections, known as nerves (Uran, 2013). To comprehend this intricate brain structure, extensive research has been conducted, leading to the development of various models explaining the relationship between the brain and the human body.

3. Brain Models

Today, there are three brain models: the right and left brain model by Robert Ornstein and Roger Spreery, the triple brain model by Paul McLean, and the holistic brain model, which divides the brain into four regions, by Ned Herrmann (Onan & Akgül, 2012).

3.1. Right Brain-Left Brain Model

The separation of the right and left lobes in the brain's structure is of great importance for understanding its functioning. Roger W. Sperry, in his studies on the cerebral cortex of cats, revealed that the brain is divided into two different hemispheres, the right and left hemispheres. This work enabled Sperry to win the Nobel Prize (Boydak, 2004, p.1). According to Sperry (1975), the brain is divided into two by a fiber layer known as the corpus callosum, and the right brain and the left brain, which emerge as a result of this separation, have different capacities and mental characteristics. Investigations on the right and left brain separation continued with many different studies.

Studies on the hemispheres have revealed differences in their functions and abilities. In general, the left hemisphere is responsible for analytical thinking, while the right hemisphere is associated with intuitive thinking

(Laccino, 2014). When the right and left hemispheres of the brain are considered functionally, tasks such as creating numbers, words, lists, sequences and lines, together with skills involving logic and analysis, are the task of the left brain. While the right brain handles situations as a whole, it undertakes the tasks of perception of space and size, colors and rhythm, and also the right brain is the center of imagination (Buzan & Barry, 2018).
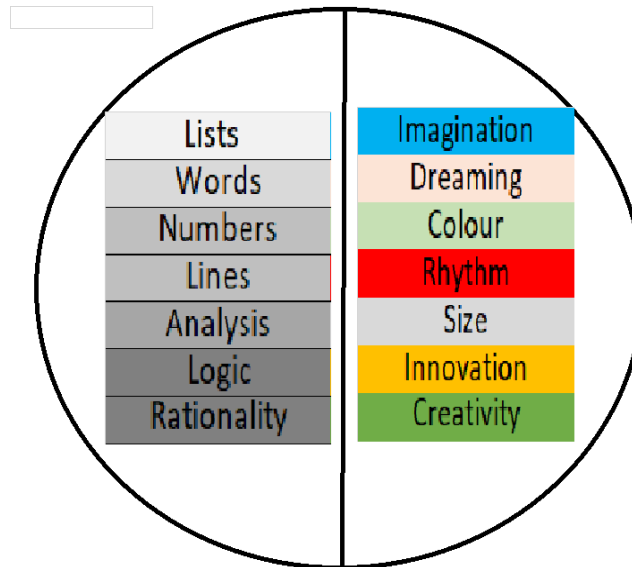
Figure 2. Mental functions of the right and left hemispheres of the brain (Buzan & Barry, 2018)

When considering the brain as two hemispheres, a relationship between the right brain and economic growth can be established. Factors such as patenting and innovation, which play a vital role in economic growth, are closely linked to the development and effective utilization of the right brain. The top of three countries in the patent applications are the United States, Japan and China (Kavaklı & Saygılı, 2019). When evaluating the production capacity of these three countries and their position in the world economy, the importance of creative intelligence and the right brain becomes evident. An examination of the utilization of the right brain reveals that while this rate is 5% worldwide, it significantly increases to to 60% and 80% in countries with high invention rates such as Japan, China and Korea (Karaman, 2015).

In the right-brain-left-brain distinction, an inference was made regarding economic rationality. According to Yılmaz (2020), it can be suggested that individuals who predominantly use the left lobe of the brain are more rational than those who predominantly use the right lobe of the brain.

3.2. Triune Brain Model

The Triune Brain theory, originally formulated by Paul MacLean, postulates a hierarchical progression in the development of the human brain, delineated into three distinct segments: the reptilian brain, the mammalian brain (specifically referred to as the palaeomammalian brain), and the cerebral cortex (Herrmann, 2003). This structure, known as the limbic system, includes the amygdala, hippocampus, hypothalamus, thalamus and pineal gland (Derrington & Goddard, 2007). The limbic system emerges as the third significant neural system in its development,

both in terms of its morphological and functional attributes, during early childhood. It possesses the remarkable capacity to shape and refine the physical, instinctual, and social aptitudes of the organism in response to its early experiential encounters. This adaptive prowess enables the limbic system to effectively modulate an individual's responses and behaviors, aligning them with the exigencies of their specific environmental context." (Livingston, 2013) The neocortex or upper brain (neomammalian brain) is the part that enables rational thinking and separates people from each other. It is divided into right and left brain. It provides mental activities such as thinking, planning and creativity. The upper brain consists of parts such as frontal, occipital, parietal and temporal (Derrington & Goddard, 2007).
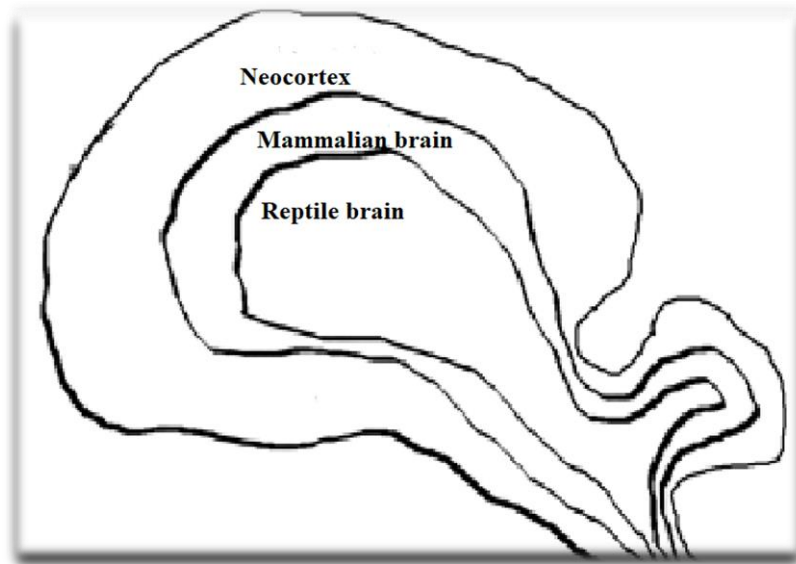
Figure 3. Triune Brain (Herrmann, 2003)

The limbic system exercises regulatory control over emotional states and fundamental cognitive processes that manifest in response to heightened states of arousal. The limbic system, also known as the intermediate brain, assumes responsibility for processes characterized by heightened emotional reactivity, such as anger, as well as the consolidation of acquired knowledge, as elucidated in the study by Canan (2023). According to views before Mac Lean, the neocortex part of the brain dominated the lower two parts. However, Mac Lean revealed that in the event of a threat, the reptilian brain comes into play and dominates the rational brain, but this phenomenon is questioned by neuroscientists (Derrington & Goddard, 2007).

Herrmann criticized the Right Brain-Left Brain Model put forward before him and thought that this model should be combined with the Triune Brain (Herrmann, 2003, p. 26).

3.3. Holistic Brain Model

The Whole Brain (Four-Quarter Model) was developed by Ned Herrmann as a more comprehensive model by combining the Right Brain-Left Brain Model and the Triune-Brain Model (Lumsdaine & Lumsdaine, 1995; Onan & Akgül, 2012). Herrmann developed the "Herrmann Brain Dominance Instrument" with more than 110,000

participants, which has strong validity and is used in 7 languages (Herrmann, 2003). With this tool, Herrmann divided the brain into four quadrants according to the dominant use of the participants.
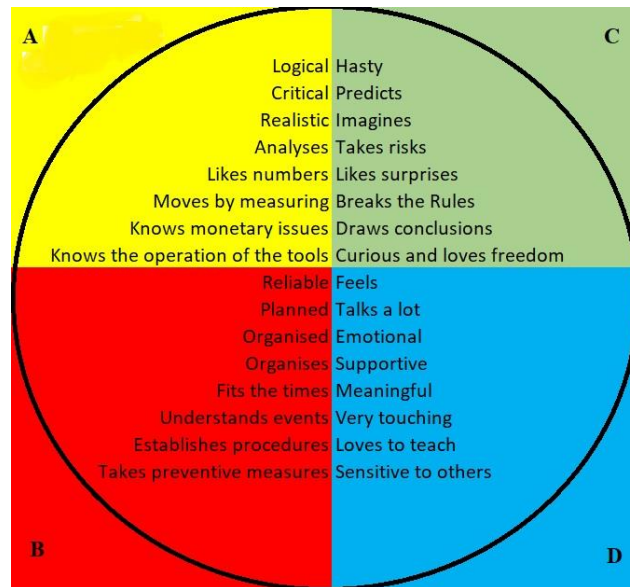
Figure 4. Four Quarter Model (Hermann, 2003)

Herrmann introduced the concept of "dominance" for individuals who use one part of their brain more intensely (Herrmann, 2003). For example, left-brain dominant people are logical, realistic and planned. Right-brain dominant people are risk-takers, dreamers, and innovators. Left-brain dominant users perceive information in numbers and words, while right-brain dominant learners learn with elements such as imagination, colors and shapes. (Avcı & Yagbasan, 2008). Per Hermann (2003, p. 40)'s framework, an individual's brain can be analyzed in relation to their dominant cognitive orientation within the context of professional endeavors. Illustrated in Figure 4 of the model, this analysis delineates specialized aptitudes associated with specific cerebral domains."For those who use the A quarter dominantly; "solo work, applying formulas, data analysis, combining objects, conflicting objects, solving problems, manipulating numbers, challenging, analyzing and diagnosing, explaining objects, explaining topics, logical operation",

For those who use the B quarter; "creating things, being in control, creating an orderly environment, maintaining the status quo, paperwork, queuing, planning, stasis, getting work done on time, paying attention to details, structured tasks, providing support, stewardship",

For those who use the C quarter dominantly; "forming groups that will work well together, expressing ideas, building relationships, learning, listening and speaking, working with people, persuading people, being part of a team, communication statements, helping people, explanatory writing, coaching, consulting",

For those who use the D quarter dominant; "Taking risks, generating solutions, providing vision, having diversity, bringing change, creating opportunities to experiment, selling ideas, developing new things, designing, having freedom of action, seeing the end in the beginning, excitement".

In this context, it is pertinent to reiterate the significance of the D quadrant within the model, as it aligns with individuals characterized by a proclivity for risk-taking, experimentation, change instigation, innovation, and entrepreneurial enthusiasm. Conversely, the B quadrant is diametrically opposed in its attributes, being characterized by a penchant for controlled, status quo maintenance, staticity, and meticulous attention to detail. It is imperative to underscore that the Herrmann Brain Dominance Tool serves as a tool for delineating an individual's cognitive predilections within the realm of thought, taking into account factors such as their educational background, hobbies, self-assessments, and overall lifestyle. Consequently, it offers insights into mental preferences while refraining from rendering judgments regarding innate abilities and competencies. It is pertinent to recognize that adeptly matching one's mental disposition with their chosen career path can significantly bolster motivation and enhance workplace performance. In contrast, the Herrmann Brain Dominance Tool primarily serves as a gauge of an individual's cognitive predispositions and their adaptability within the professional sphere. Figure 5, as presented by Herrmann in 2003, illustrates the distribution of occupational profiles across the four cerebral quadrants, offering a visual representation of their dominance. Looking at the occupational profiles, it can be posited that in Herrmann's holistic brain approach, it is the first good situation for people to choose a profession according to their brain dominance. On the other hand, it is asserted that brain dominance develops according to the working structure of the professions.

According to Kuznets (2015), the determination of career choices according to the element of merit is the determinant of modern economic growth. Merit is defined in the Dictionary of the Turkish Language Institution as "a person's suitability and suitability for employment" (TDK, 2023). From the provided definition, it is evident that the brain dominance profiles of prospective employees constitute a noteworthy determinant of their potential contributions within an organizational context. Given the profound impact of the recruitment of highly skilled individuals on economic growth, Herrmann's research assumes a broader significance extending beyond the confines of the corporate sector. Indeed, Herrmann's work not only holds value within the business realm but also carries implications for the broader field of economics. In the Right Brain-Left Brain Model and the Four Quarter Model, the right brain comes to the fore in features such as daydreaming, risk taking, innovation, creativity and entrepreneurship.

Comprehensive Literature Analysis

Literature investigations pertaining to the subject matter exhibit two distinct organizational approaches. Firstly, the discourse unfolds through an exploration framed within the paradigms of creativity and innovation, as expounded by the right-brain-left-brain model. Secondly, a distinct line of inquiry encompasses studies that delve into entrepreneurship or the realms of creativity/innovation, embracing perspectives rooted in the right-brain-left-brain model or adopting a more holistic-brain approach. Arguably the most salient facet within the paradigm of the right-brain-left-brain dichotomy, which has engendered a paradigm shift in the realm of human brain research, centers on the construct of creativity. According to Kane and Kane (1979), each side of the brain has different cognitive functions and the right side of the brain is creative. Fink et al. (2009) reported non-significant disparities between both cerebral hemispheres. Mihov et al. (2010) revealed that the right hemisphere is more creative with their meta-analytic analysis of left and right hemispheres on creativity. According to Gold and Ben-Artzi (2011)'s metaphors

and verbal creativity study for the right and left hemispheres, the right hemisphere also performs the task of the other hemisphere. Piaw (2014) revealed in a study that the right brain is more creative.

An examination of extant literature pertaining to the relationship between the right hemisphere of the brain and creativity reveals a prevalent assertion aligning the right hemisphere with a greater propensity for creative and innovative functions, in accordance with the tenets of the Right Brain-Left Brain Model. In the studies examined in the study and listed below, Right Brain-Left Brain and Whole Brain Models were discussed in terms of entrepreneurship and/or creativity.

In a research endeavor conducted by Huefner et al. (1996), an examination was undertaken to compare the Herrmann Brain Dominance assessment, the Myers-Briggs Type Indicator, the Entrepreneurial Attitude Orientation Scale, and the Entrepreneurship Coefficient Scales. The outcome of this investigation revealed that the Entrepreneurship Coefficient Scale emerged as the most effective discriminator among the assessed instruments, while the Entrepreneurial Attitude Orientation Scale occupied the position of the second-most discriminating measure. Furthermore, with regard to the domain of entrepreneurship, the D quadrant, situated in the upper-right segment of the Herrmann Brain Dominance Scale, emerged as the sole statistically significant group when contrasted with the remaining three quadrants. This observation closely aligns with the theoretical framework advanced by Herrmann (1988).

In the investigation conducted by Buergin (1998), the primary objective was to discern disparities in brain dominance patterns among Swiss entrepreneurs and managers, along with the consequent cognitive thinking styles that ensued. Employing the Herrmann Brain Dominance Tool as the principal assessment instrument, the study sought to elucidate the cognitive predispositions characterizing these distinct professional groups. As a result of the study, the right brain of the entrepreneurs is dominant compared to the managers. There was no significant difference in terms of limbic modes. Both groups preferred the cerebral mode, with entrepreneurs significantly favoring the D quadrant of the brain compared to managers. A positive correlation was found between the right hemisphere and achievement motivation.

Kirby (2004) aimed to evaluate the entrepreneurial tendencies of the participants in his study with 30 young people with Attention Deficit and Hyperactivity Disorder (ADHD). Durham University General Entrepreneurship Test was used in the study. As a result, it was found that young people with ADHD who participated in the study were more entrepreneurial and had a right-brain learning preference compared to other young people.

The Herrmann Brain Dominance Tool was used in a study conducted by Güney and Nurmakhamatuly (2007) with a total of 353 Kazakh and Turkish university students. The primary objective of the study is to examine entrepreneurship in the intercultural dimension. As a result of the study, it has been seen that Kazakh students are more controlled and balanced than Turkish students, and Turkish students come to the fore with their more reliable and creative personalities.

Demirel and Tikici (2010) undertook an investigation exploring the correlation between right-brain dominance and entrepreneurship within the demographic of university students. The study's findings indicated a propensity for

heightened right-brain activity in the cultivation of an entrepreneurial culture. Additionally, the research posited that, among the student cohort, the right hemisphere exhibited a greater degree of cognitive strength when compared to the left hemisphere. Demirel et al. (2011) examined the effect of multiple intelligence theory on entrepreneurship. Multiple intelligences with 212 SME owners were found to be effective on entrepreneurship. Furthermore, it was found in the study that right-brain characteristics were more effective on entrepreneurship than left-brain characteristics.

Kürtüncü et al. (2019) examined the effect between the dominant hemisphere of the brain and assertiveness and entrepreneurship in a study involving 1167 university students. As a result of the study, it was found that the brain dominant sphere affects entrepreneurship positively.

Concluding Remarks and Critical Analysis

If we were to analogize the economy to a structural edifice, entrepreneurs would aptly represent the foundational pillars thereof. It is conceivable that innovative and creative entrepreneurs assume pivotal roles within the economic growth paradigm, particularly in the context of value-added product and service generation. In the course of this investigation, an examination was undertaken to assess the cerebral attributes requisite for fostering innovative and creative entrepreneurship. When the brain is considered as hemispheres, it is remarkable that innovation/creativity takes its place among the functions of the right brain. Undoubtedly, patents, inventions and inventions are the product of creative thinking. When considered as such, the use of the right brain also affects economic growth through innovation. It becomes evident that the cultivation of right-brain attributes and their conscious recognition among entrepreneurs is imperative to stimulate economic growth. According to Filion and Dolabela (2007), entrepreneurship is possible with the development of the right part of the brain (creative and intuitive resources). This objective can be realized through the implementation of training programs aimed at nurturing visionary capacities and translating those visions into tangible reality. These programs should be systematically integrated into the educational framework, commencing from the primary education tier and extending throughout the educational continuum. It is noteworthy that imparting such training prior to the onset of adolescence holds particular merit in terms of optimizing the efficacy and impact of these pedagogical initiatives. According to Çalışkan and Dilmaç (2021), adolescence is a period in which personality changes are experienced and the effort put forward in terms of reaching future goals is valuable.

Furthermore, it is worth emphasizing that within the context of fostering and eliciting right-brain development in individuals during their formative years in primary school, the educators assume a paramount role. Regardless of the educational system or pedagogical approach employed, it is discernible that the foremost influential factor in shaping and advancing students' cognitive development is the pivotal role played by educators, as articulated by Traş and Arslan (2013). At this juncture, it becomes imperative to heighten the consciousness of educators operating within the domain of primary education concerning the significance of nurturing right-brain development and the proficient recognition of students who exhibit a predominant utilization of their right cerebral hemisphere. Right-brain dominant people, who can be said to be natural entrepreneurs, need to be supported in terms of adapting to difficult living conditions as well as identifying and training them. Individual therapy or group therapy management can also

contribute to their personality development in order to develop entrepreneurial individuals in terms of problem solving and struggling with difficult conditions (Traş & Aydın, 2019).

After primary education, the MBA program in the field of Creative and Cultural Entrepreneurship, developed by Bandung University of Technology with Goldsmiths University, can be presented as an example in terms of ensuring continuity with programs that develop creative and innovative thinking, especially in undergraduate and graduate education. This program focuses on developing the right brain with courses such as creativity, art and design. The courses aim to develop creative and innovative thinking to produce value-added products/services (Larso & Saphiranti, 2016).

According to Türkel and Dilmaç (2019), with the widespread use of the Internet with Web 2.0, the use of social media has overshadowed conventional media tools such as television and radio, and social media tools offer services such as communication, playing games and shopping..The potency of social media, an omnipresent force permeating various facets of contemporary existence, has become particularly pronounced in the wake of the widespread adoption of smartphones. It is noteworthy that this influential platform can be harnessed as a formidable tool for the cultivation of right-brain capabilities and aptitudes.

The outcomes of the investigation substantiate a discernible and substantial correlation between economic growth and the prominence of right-brain attributes. Entrepreneurs who use their right brain effectively are needed for economic growth. Right-brain and creativity/innovation education can be developed, as well as individuals with already developed right-brain should be encouraged to become entrepreneurs. Hence, in light of these considerations, it is advisable to identify innovative entrepreneurs through modalities such as the incorporation of right-brain training methodologies that bolster creative intelligence within educational curricula and assessment scales rooted in Herrmann's comprehensive brain model.

In the context of this perspective, a delineation of prospective actions may be enumerated as follows:• Right-brain-based trainings should be designed in every period of education life.

• Schools should be equipped with toys and laboratories that will develop the right brain.

• Trainers need to be trained for the training of the right back and the identification of the individuals who use their right brain dominantly.

• It is necessary to identify people who use their right brain dominantly in primary school and to support them to be successful entrepreneurs, innovative structures and personality developments.

• Right brain developing design and creativity trainings should be organized even after primary school age.

• One potential recommendation involves the development of social media initiatives, interactive games, and applications specifically designed to enhance right-brain cognitive faculties.

• In incentive and grant programs, it may be recommended to apply tests that analyze the brain's structure and dominance to candidate entrepreneurs, and as a result of these tests, it can be suggested that entrepreneurs who use their right brain be primarily supported.

• With models such as the angel investor model, innovative initiatives can be identified and financial support can be provided to business ideas.

The use of brain regions in different dominances is crucial for employment and employee productivity, and in future studies, the relationship between the structure of the brain and economic growth can be discussed in terms of employment. Furthermore, forthcoming research endeavors may contemplate investigations into the interrelationships among diverse theories of intelligence, personality typologies, and sensory representation systems (including visual, auditory, and kinesthetic modalities) in relation to their potential impact on the dynamics of economic growth.

Ethic

I affirm that the research adhered rigorously to the ethical guidelines stipulated by the institutional and national research committee, as well as aligning with the principles outlined in the 1964 Helsinki Declaration and its subsequent revisions, or analogous ethical benchmarks.

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Evaluation of Psychological Help Needs, Stress and Hopelessness Among Postgraduate Students

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Abstract

Today, there is an observable increase in the demand for psychological help among individuals of all ages and educational levels. Hence, revealing the factors associated with the need for psychological help can support mental health professionals in planning more effective interventions. This study aims to examine the psychological help needs of graduate students concerning stress and hopelessness. The research sample comprises 255 master's and doctoral students from various universities To measure the study's variables, the Perceived Stress Scale, Beck Hopelessness Scale, and Psychological Help Need Scale were employed. Multiple linear regression analysis was utilized in this research to determine the predictive relationship between independent variables and the dependent variable. The results obtained from the analysis indicated a significant correlation between psychological help need, perceived stress, and hopelessness. Additionally, both stress and hopelessness were identified as significant predictors of psychological help need.

Key Words

Hopelessness • Postgraduate student • Psychological help need • Stress

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Introduction

In response to the demands of advancing technology and the information age , people are expected to be able to adapt to the changing world. In order to achieve this, individuals need to continuously update their knowledge and be willing to learn. In the face of the ever-increasing need for knowledge, the knowledge acquired through undergraduate education is not sufficient for individuals throughout their lives (Karakütük, 2001). After undergraduate education, individuals can continue their postgraduate education in order to improve their knowledge and skills and contribute more to society. The postgraduate education process includes master's degree with thesis, master's degree without thesis, doctorate and proficiency in art programs (İşcan & Bıkmaz, 2012). Students' expectations for graduate education are primarily to improve themselves, gain academic competence and build a career (Alabaş et al., 2012; Gömleksiz & Yıldırım, 2013). In Golde and Dore's (2001) study, it was determined that doctoral students' expectations from doctoral education were to have an academic career.   In Gemme and Gingras' (2012) study, the primary motivations for students to pursue postgraduate education were to enhance their job prospects and elevate their social status.

According to Toprak and Taşğın (2017), one of the most important reasons why students do not pursue postgraduate education is that this process is quite intense and exhausting. It is stated that emotional burnout is frequently experienced during graduate education due to reasons such as attendance to courses, economic concerns, heavy workload, organizational injustice, and social conflict (Alabaş et al., 2012; Stubb et al., 2011; Toprak & Taşğın, 2017). Related studies show that negative emotional symptoms such as burnout, stress and anxiety are high in graduate students (Stubb et al., 2011), and stress has been found to have a direct correlation with depression and anxiety (Hassan, 2019). In a similar study conducted by Shete and Garkal (2015), it was emphasized that factors such as work intensity, lack of sleep, competitive environment during graduate education increase stress in students and this stress leads to destructive psychological symptoms such as anxiety and depression. Stress is defined as a feeling of tension and pressure that occurs in an individual against a real or imagined situation or stimulus (Everly & Lating, 2002). While low levels of stress are considered beneficial because they support the individual's performance and adaptation to the environment, high levels of stress can harm the individual mentally and physically (Kamaruddin & Mamat, 2015). Intense stress is associated with a range of mental and physical problems, including depression, anxiety disorders, suicidal tendencies, post-traumatic stress disorder, alcohol and substance abuse, and cardiovascular diseases (Kamaruddin & Mamat, 2015). It is stated that intense stress is effective in the increase of many mental and physical risk factors such as depression, anxiety disorders, suicidal tendency, post-traumatic stress disorder, alcohol-substance abuse, cardiovascular diseases (Hammen, 2005).

One of the important variables associated with stress in individuals is hopelessness (Özdemir et al., 2022). Hopelessness is defined as a mental state that includes negative expectations about the future. These expectations encompass beliefs that negative situations will remain unchanged, along with negative self-evaluations (Abbey, 2006; Beck, 2005). It is stated that hopelessness is closely related to depression, anxiety, somatization, negative self-perception and hostility, which are defined under psychological symptoms (Vatan & Dağ, 2009) and that many young people in Turkey are in the risk group in terms of hopelessness (Erkan et al., 2012).   Considering the

significant impact of hopelessness on general well-being and psychological health, it is imperative to investigate its potential effect on individuals in need of psychological assistance.

Psychological help-seeking behavior includes the process of contacting the necessary people for treatment, information and advice, or the need for understanding, as well as receiving support to cope with stress situations or to solve problems (Rickword et al., 2005). The process of seeking psychological help involves three key steps: awareness of one's problem and need, the decision to seek help, and contacting a mental health professional (Saunders, 1993). In this direction, individuals' awareness of their need for psychological help is seen as the first step. In studies related to the need for psychological help, it has been found that young people mostly seek help for issues such as emotional problems, romantic relationships, family relationships, substance / cigarette use (Topkaya & Meydan, 2013). It is seen that the number of studies on the need for psychological help in Turkey is quite limited and these studies were conducted with university students (Ay, 2014; Akeren & Ay 2019; Topkaya & Meydan, 2013) and adolescents (Savi Çakar & Kılınç, 2020).

In the literature review, no research was found that revealed the psychological problems experienced by individuals during graduate education and the need for psychological help in this process. Understanding the need for psychological help that may arise in this challenging and exhausting process, which includes many stress factors such as unemployment, economic difficulties, intense work tempo, intense competition; It is considered important to protect the mental health of individuals continuing postgraduate education and to plan and implement the necessary preventive and therapeutic mental health studies. In this context, it is thought that studies to determine the psychological help needs of graduate students are important for the more systematic implementation of preventive and preventive interventions carried out in universities and the creation of effective intervention plans that include crisis situations.

This study aimed to examine the predictive power of perceived stress and hopelessness on the level of psychological help needed by graduate students, In this direction, the following questions were included in the research:

1. Is there a significant relationship between perceived stress, hopelessness and psychological help need among graduate students?

2. Do perceived stress and hopelessness significantly predict the psychological help need in graduate students?

Method

Research Model

The research model is a relational survey model used to determine the existence and level of the relationship between variables (Fraenkel & Wallen, 1996).

Working Group

The participants in this study comprised 253 master's and doctoral students who were pursuing their postgraduate education at various universities during the 2022-2023 academic year. Snowball sampling, a non-

random sampling method, was employed to select participants, and data were collected using Google Forms. Demographic information for the participants is presented later in this paper.

Tble 1

Demographic Information of the Participants

		Frequency(N)	Percentage (%)	Total
Gender	Female	205	81	253
	Male	48	19	
Educational level	Master's degree	183	72.3	253
	PhD	70	27.7	
Work status	Working	147	58.1	253
	Not working	106	41.9	

There were 253 participants in the study, of which 205 (81%) were female and 48 (19%) were male. Regarding their educational level, 183 (72.3%) of the participants have a master's degree and 70 (27.7%) have a doctorate degree. In terms of employment status, 147 (58.1%) of the participants were employed and 106 (41.9%) were not employed.

Data Collection Tools

For this research , the Need for Psychological Help Scale was used to determine the participants' need for psychological help, the Perceived Stress Scale was used to determine their stress levels, and the Beck Hopelessness Scale was used to determine their hopelessness levels. "Personal Information Form" prepared by the researcher was used to determine the gender and education level of the participants.

Personal Information Form. The personal information form includes information about the participants' gender, education level and employment status.

Psychological Help Need Scale. The 'Psychological Help Need Scale,' developed by Ay in 2014, measures the need for psychological help. The 35-item 5-point Likert-type scale consists of sub-dimensions such as safety, love, respect, and self-actualization. The sub-dimensions of the scale can be scored separately or the psychological help needs of the individuals can be determined by calculating the total score. The internal consistency coefficient of the scale was .92 and the test-retest coefficient was .72 (Ay, 2014). In this study, Cronbach's alpha of the scale was found to be .93.

Perceived Stress Scale (PSS-10 Form). The Turkish adaptation of the Perceived Stress Scale, originally developed by Cohen et al., was conducted by Eskin et al. in 2013. Three different forms of the scale including 'Perception of Inadequate Self-Efficacy' and 'Perception of Stress/Discomfort' dimensions were developed as PSS-14, PSS-10 and PSS-4. In this study, the PSS-10 form, which consists of a total of 10 items, was used. The Perceived Stress Scale was developed to measure the extent to which individuals perceive various situations in their lives as stressful. The internal consistency coefficient of the 5-point Likert-type scale was calculated as 0.82 and the test-retest coefficient was calculated as .88 (Eskin et al., 2013). In this study, Cronbach's alpha of the scale was .84.

Beck Hopelessness Scale. The Turkish adaptation study of the Beck Hopelessness Scale, originally developed by Beck was conducted by Seber et al. (1993). In the study, the scale demonstrated strong reliability, with a Cronbach's alpha coefficient of .86 and a test-retest coefficient of .73. In responding to the IPS, participants are instructed to mark 'true' for statements that apply to them and 'false' for statements that do not. The scale items are categorized into three sub-dimensions: feelings about the future, loss of motivation and expectations about the future. There are 1st, 6th, 13th, 15th, 19th items in the feelings about the future dimension, 2nd, 3rd, 9th, 1st, 12th, 16th, 17th, 20th items in the loss of motivation dimension, and 4th, 7th, 8th, 14th and 18th items in the expectations about the future dimension. The total score obtained from the scale corresponds to the 'hopelessness' score. The scale has a score range of 0-20, where a higher score indicates a higher level of hopelessness (Seber et al., 1993). In this study, the scale exhibited strong reliability, with a Cronbach's alpha coefficient of .91.

Data Collection and Analysis

The research data were obtained online through google forms from individuals continuing their postgraduate education at various universities. In the analysis of the data, Pearson Correlation Coefficient Analysis was used to examine the relationship between dependent and independent variables and Multiple Linear Regression Analysis was used to determine the predictive power between variables (Büyüköztürk, 2010).

Results

In this section, the findings of the statistical analyses are reported.

Table 2

Descriptive Statistics on Participants' Psychological Help Need, Perceived Stress and Hopelessness Level

	Mean	Sd	Skewness	Kurtosis
Psychological Help Need	81.7149	19.32205	.492	.802
Perceived Stress	25.6024	5.99652	-.316	.641
Hopelessness	8.6747	5.59040	.354	-1.043

When the data in Table 2 are examined, it is seen that the Skewness and Kurtosis coefficients are within the range of ±1. The fact that these coefficients are within the ±1 limits is interpreted as a normal distribution of the data (Büyüköztürk, 2010).

Table 3

Correlation Results for Determining the Relationship between Psychological Help Need, Stress and Hopelessness

Variables	1	2	3
1. Psychological Help Need	1		
2. Perceived Stress	.408**	1	
3. Hopelessness	.553**	.412**	1

As a result of the correlation analysis, it was found that the psychological help need had a moderately significant relationship with perceived stress (r=.408 $p<.01$) and hopelessness (r=.553 $p<.01$). There was also a moderately significant relationship between perceived stress and hopelessness variables (r=.412 $p<.01$).

Before conducting the multiple linear regression analysis, it was necessary to verify whether the prerequisites for the analysis had been met. In order to perform a multiple linear regression analysis, certain conditions must be satisfied: the variables should exhibit a normal distribution, there should be a linear relationship between predictor and predicted variables, and no multicollinearity issue should exist among the independent variables (Büyüköztürk, 2010). The skewness and kurtosis coefficients in Table 2 indicate that the data are normally distributed. The correlation coefficients in Table 3 show that there are linear relationships between the dependent and independent variables ($p<.01$). The Durbin Watson value of 1.91 indicates that there is no autocorrelation. In addition, the fact that the correlation between perceived stress and hopelessness variables is below .80 and the Tolerance and VIF values (Tolerance>.20), (VIF<10) are in the desired range shows that there is no multicollinearity problem between variables.

Table 4

Multiple Linear Regression Analysis Results Regarding the Prediction Level of Perceived Stress and Hopelessness on the Psychological Help Need

Predictor Variable	B	St. Error (B)	β	T	p	Zero-order r	Partial R
Constant	49.750	4.410	--	11.281	.000	--	--
Perceived Stress	.724	.185	.225	3.919	.000	.415	.242
Hopelessness	1.547	.198	.448	7.805	.000	.543	.446
	R= .58 R²= .34			*F(2,251) = 62,298*			
	Durbin-Watson=1.91			**p=.000*			

The fact that the *F* value is significant (*F* (2,251) = 62,298 *p=.000) shows that the model is significant. According to the findings, perceived stress and hopelessness have a moderately significant relationship with the psychological help need. These two variables together explain 34% of the psychological help need scores (R= .58, R2= .34, *p<.001). When the binary and partial correlations between the variables were examined, it was seen that there was a moderately positive relationship between perceived stress and psychological help need (r=-.42) and when the hopelessness variable was controlled, this relationship was calculated as r=-.24. While there was a moderate positive relationship (r=-.54) between hopelessness and psychological help need, this relationship was calculated as r=-.45 when the perceived stress variable was controlled.

According to the (β) coefficient, the order of importance of the predictor variables on the psychological help need is (1) hopelessness and (2) perceived stress. According to the t-test results regarding the significance of the

regression coefficients, both perceived stress *(p=.00)* and hopelessness *(p=.00)* variables were found to be significant predictors of the psychological help need.

Discussion, Conclusion & Suggestions

In the study, it was found that the need for psychological help was positively correlated with stress and hopelessness in graduate students and that stress and hopelessness were also positively correlated with each other. Another finding of the study reveals that stress and hopelessness serve as notable predictors of the necessity for psychological assistance.

In the literature, there is no research directly revealing the relationship between stress, hopelessness and need for psychological help. In Aydemir and Çam's (2015) study, it is emphasized that one of the most important reasons for students to start graduate education is to gain prestige. Considering that one of the components of the psychological help need is the search for respect, it can be argued that individuals who cannot achieve the respect they seek will be under more stress, feel more hopeless about their future, and therefore need more psychological help. On the other hand, individuals in the emerging adulthood period, which lasts until the middle and even the end of their twenties, face many developmental tasks such as regulating their outlook on life, choosing a partner and career development, and searching for an identity (Arnett and Eisenberg, 2007). In other words, individuals in this period are directing their lives in the areas of educational, personal, social and career development and are trying to discover their identities. During this process, it is seen that individuals face many problems in the fields of personal, social, educational and career development (Mutlu et al., 2019). Kaygusuz (2002) revealed that university students experience problems related to school and future concerns the most, in addition, there are intense problems related to emotional issues and human relations. It may be conjectured that individuals undergoing stress and experiencing feelings of hopelessness in connection with matters such as future anxiety, career indecision, and challenges in securing employment would likely require an increased level of psychological support.

The findings of the literature show that the need for psychological help is related to variables such as suppression of emotions (Komiya et al., 2000), social support (Erkan et al., 2012), self-efficacy, self-regulation, subjective well-being and learned resilience (Ay, 2014). From this point of view, it can be thought that individuals who experience deficiencies in areas such as self-skills and social support will be under more stress and will have more difficulty in coping with this stress and therefore will need psychological help more intensely.

In the literature examining the relationship between stress and hopelessness, it is emphasized that coping skills with stress reduce hopelessness (Clements & Sawhney, 2011; Öztürk & Maçkalı, 2022), while hope facilitates coping with stress (Snyder et al., 2002). The relationship between stress and hopelessness can often turn into a cycle that triggers and reinforces each other. When stress causes negative emotional and physical reactions, a person's hopelessness may increase. In this instance, stress can exert a detrimental influence by diminishing an individual's motivation, attenuating their sense of hope, and fostering a pessimistic perspective on life in a broader sense.

On the other hand, hopelessness can also increase stress levels. A person in despair often feels that they have lost their hopes and expectations for the future and may go through life with low energy and motivation. This can

culminate in elevated stress levels and a heightened challenge in effectively managing stress. From this point of view, it can be argued that future anxiety and academic problems that arise during graduate education will trigger both stress and hopelessness and individuals will need more help.

In conclusion, this study is a first in the literature in terms of being conducted with graduate students and addressing the relationship between stress and hopelessness, two important risk factors in the field of mental health, and the need for psychological help. In this direction, it is useful to address the limitations of the study before moving on to the recommendations. In this study, snowball sampling method was used as the sampling type and it was seen that the distribution of gender and education type of the participants in the sample was not balanced. Due to the low number of male participants and the low number of participants with doctoral level, the differences related to these variables were not analyzed. In samples with a larger number of participants and a balanced distribution of gender and education type, gender and education level-based differences in stress, hopelessness and the need for psychological help can be examined. However, in future studies, different psychological and demographic variables that may be related to the need for psychological help can be addressed; preventive and curative mental health interventions for graduate students at universities can be planned and put into practice. Considering the cyclical relationship between stress and hopelessness and their predictive effects on the need for psychological help, interventions aimed at providing students with the ability to cope with stress and a positive outlook towards the future are considered important. Academic counselors can be given awareness trainings to recognize students' needs and provide necessary guidanceIn essence, it becomes imperative to take into account the requirements of graduate students, along with other cohorts of students, within the framework of psychological support services administered within academic institutions, and to facilitate the dissemination of requisite interventions. In addition, it is important to disseminate studies that address the psychological characteristics, risk factors and needs of this group in literature studies in order to plan and implement the necessary mental health services.

Ethic

I declare that the research was conducted in accordance with the ethical standards of the national research committee and the 1964 Helsinki declaration.

Author Contributions

This article was written by a single author.

Conflict of Interest

There is no conflict of interest.

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Mathematics on News: How do Students Interpret Percentages in Daily Life Situations?[*]

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Abstract

Contexts with real-life situations can be more motivating for students, increase students' attitudes and interest, and strengthen the connection between mathematics and daily life. This study examined student interpretations of News texts consisting entirely of real-life situations and including percentage representations. In this qualitative case study, data were obtained from 30 8th grade students. Students were asked 6 News texts containing various percentage values and were expected to explain what they understood from these percentage values. The data obtained from the study were subjected to content analysis and interpreted by authors. The results indicate that students have difficulty in interpreting real-life situations involving percentage representation, and very few students make clear and understandable comments about real-life situations. It suggests that most students focused solely on the numerical growth of the percentage expression. Some students struggled with the News text, while others provided irrelevant, unclear, or meaningless responses. According to these findings, it is recommended that students' interpretations of real-world context in mathematics lessons be discussed more frequently in the classroom settings.

Key Words

Contexts • Mathematics • Middle school students• Percentages • Real life situations

Introduction

One of the most important goals of school mathematics is to enable students to connect mathematics with daily life. In this context, the Program for International Student Assessment (PISA), which is conducted by the Organization for Economic Cooperation and Development (OECD) every three years, measures the extent to which 15-year-old students can use the knowledge and skills they learn at school in daily life (MoNE, 2020; OECD, 2012). The concept expressed as mathematical literacy in PISA refers to a person's ability to reason, analyze, formulate and solve tasks in a real-world situation (Hope, 2007). The tasks in PISA are categorized according to various proficiency levels and each task includes a daily life context. All tasks in PISA fall into scientific, social, personal or occupational categories, and it is ensured that the tasks include realistic situations as much as possible (Kabael & Barak, 2016). In this regard, PISA reports offer a second classification framework that categorizes tasks based on how realistic the contexts are presented (OECD, 2009). This framework classifies tasks into three categories: level 0, level 1, and level 2. Zero-level contexts are defined as unrealistic, camouflage or dressed-up contexts in which the student does not need the context to solve the task, while first-order contexts are more realistic and require the student to understand the context in order to solve the task. Second level contexts are defined as real-life situations in which requires mathematization process. Although PISA reports mention the difficulty of preparing second level tasks, it is stated that students should encounter such contexts as often as possible. Studies have shown that real-life situations are more motivating for students, increase students' attitudes and interest (Stylianies & Stylianides, 2008), and strengthen the connection between mathematics and daily life (Singletary, 2012; Özgeldi & Osmanoğlu, 2017). Therefore, in this study, context examples taken entirely from real-life situations were included. Within the scope of the study, student interpretations on News texts containing percentage representation were analyzed.

Percentage notation is one of the most common mathematical representation that students encounter in daily life. Students frequently come across this notation on various platforms , including shopping, advertisements, newspapers, and the internet, even though percentages have been introduced in the mathematics classroom since middle school. In their everyday lives, they encounter large-scale representations of discounts, increases, decreases, and more in store windows and markets. They often notice prominent signage about sales, price hikes, reductions, and other related topics in storefronts and market displays. Percentage notation provides the opportunity to visually understand how different numerical data contribute to a hundred-unit scale. Employing percentage notation can help individuals better grasp the facts and discern their differences. Despite the apparent and widespread nature of the concept of percentages, numerous studies have found that students often struggle with it (Özçelik & Tutak, 2017; Lestiana, 2021; Parker & Leinhardt, 1995).

 Percentage expressions are a means of representing values, including rational numbers, fractions, and decimals. How many objects would be represented, for instance, if 10 items in 20 items were included in 100 items? Actually, it is clear from this perspective that percentage statements are based on proportion. Indeed, Piaget and Inhedler (1973) also argue that percentage expressions are based on proportional reasoning. Here, the student can reach the result by expanding the denominator of the fraction 10/20 by 5 and making the denominator one hundred. Perhaps many percentage tasks can be solved with this method. However, the student may be making the denominator one

hundred without understanding the concept of percent conceptually. The findings in Koay's (1998) study show that being able to read percent expressions and to make calculations correctly does not lead to the ability to interpret and apply the concept of percent in context. This underlines the importance of conceptual understanding of the percent expression in context.

Numerous studies have been conducted on a variety of topics, including students' difficulties with percent expressions (Lestiana, 2021; Özçelik & Tutak, 2017), the impact of realistic mathematics education on percent achievement (Özçelik & Tutak, 2017), problem-posing skills for percentages (Doğuz-Karahan, & Genç, 2022), and supporting students' percent representation skills (Rianasari, Budaya, & Patahudin, 2012). However, there is no prior research that specifically examines the interpretation of percentage expressions in the context of real-life situations presented in News texts. Considering that percentage expressions are a concept that is very intertwined with life, the meaning that students attribute to the expressions in News texts gains importance. Therefore, the following research question is being addressed within the purpose of the study:

In the context of mathematical literacy, what are the 8th grade students' interpretations of the percentages in the News texts?

Method

This study utilized a qualitative research approach to investigate how students comprehend percentages in News texts in the context of mathematical literacy. It employed the case study design, one of the qualitative research techniques. Case studies are a type of research method that can be used to provide explanations for how and why questions happen in real-life situations where the researcher has no control over the variables (Yin, 2009; Ozan-Leylum, 2017). According to Yıldırım and Şimşek (2011), case studies are a research approach that enables the researcher to thoroughly explore a phenomenon or event without being able to influence it, using 'how' and 'why' questions.

Participants and Data Collection

In this study, it was aimed to determine the competencies of 14-15 year old students, who also constitute the sample level of PISA, regarding daily life situations by examining their interpretations of daily life contexts.Therefore, 30 8th grade students were asked to read 6 News texts containing contexts with various percentage values and were expected to explain what they understood from these percentage values. The News texts were presented to the students on a paper together with their visuals in order for them to be able to interpret on the situations involving percentage values. The percentage contexts were classified into three different groups. For example, "House prices in the EU increased by 42 percent in the last ten years" or "Grain exports increased by 28 percent" were examples of statements in the first group that had percentage values between 1 and 100. The second set had statements like "Reading rate increased by 1,000 percent" and "Turkey's tourism income increased by 1,000 percent," which were expressed in terms of percentage values greater than 100. The third group includes statements such as "Exports decreased by 0.6 percent in Çankırı" and "The amount of cow's milk increased by 0.6 percent" which had percentage values ranging from 0 to 1 (Table 1).

Table 1

Real Life Contexts on News Texts

Contexts with a percentage value between 1 and 100	Contexts with percentage value more than 100	Contexts with percentage value between 0 and 1
https://www.maltahaber.com/abde-son-10-yilda-konut-fiyatlari-yuzde-42-artti/	https://www.yerelguc.com/gundem/okuma-oraninda-yuzde-bin-artis-h8599.html	https://www.bursatv.com.tr/amp/ekonomi/inek-sutu-miktari-yuzde-06-artti-h995099.html
Translation: House prices in the EU increased by %42 in the last ten years	Translation: Thousand percent increase in reading rate	Translation: The amount of cow's milk increased by %0.6
https://www.sabah.com.tr/ekonomi/hububat-ihracati-yuzde-28-artti-6163736	http://m.gunhaber.com.tr/default.asp?page=haber&haberid=505112	https://www.trthaber.com/haber/guncel/cankirida-haziran-ayinda-ihracat-azaldi-699107.html
Translation: Grain exports increased by %28	Translation: Turkey's tourism revenue up 190 percent	Translation: Exports decreased by %0.6 in Çankırı

A pilot study was conducted before the main study. According to the results of the pilot study, the data collection tool was revised stylistically and made more understandable by the students. Additionally, the pilot study revealed that students in 6th and 7th grade had trouble comprehending how to analyze News texts, so it was decided to extend the study to 8th graders. After the data collection tool was finalized, the researcher distributed data collection papers to students, provided 40 minutes in the classroom setting and students were expected to write their interpretations about the News texts. Since the results of the pilot study showed that there were too many personal comments on the News texts, the researcher made the necessary explanations before distributing the data collection papers to the students.

Data Analysis

One of the qualitative data analysis techniques, content analysis, was used to classify the data obtained from student responses. The aim of content analysis is to bring together similar data within the framework of certain concepts and themes and to interpret them by organizing them in a way that the reader can understand (Yıldırım & Şimşek, 2011). For this reason, firstly, the students were coded as S1, S2, S3......,S30 and the student responses were interpreted by two field experts. Then, categories were created in the light of the data obtained and student responses were placed in these categories by reaching a consensus of expert opinion. The student responses were assessed in

four categories: "Correct response, partially correct response, incorrect response, and blank response" resulting from the data collected from the student responses. Correct responses were divided into two categories as "giving daily life examples" and "procedural responses". Partially correct responses were divided into two categories as "Approximate value" and "Giving an example from daily life". Incorrect responses were divided into "Focusing on numerical increase/decrease" and "Irrelevant response". The meanings of these categories in the analysis framework are explained in Table 2.

Table 2

Explanation of Analysis Framework

Correct response	Giving daily life examples	The correct response that includes a daily life example related to the percentage expression in the News text.
	Procedural	The correct response that deals with the percentage expression in the News text procedurally.
Partially correct response	Approximate value	The response expressing the approximate value of the percentage expression in the News text.
	Giving daily life examples	The response that gives a daily life example about the percentage expression in the News text and partially reaches the correct response.
Incorrect response	Focusing on numerical increase/decrease	An incorrect response that includes a comment about the numerical increase or decrease in the percentage expression in the News text.
	Irrelevant response	An incorrect response that includes comments about the percentage expression in the News text that are not correct and not related to the given situation.
Blank response		No comment or statement in the explanation section

The validity and reliability of the research were ensured by the analysis and discussion of the data with two researchers until a consensus was reached during the coding phase.

Results

This section presents the results obtained from student responses. The main findings demonstrate that in the tasks asked in all three contexts, there were very few students who correctly interpreted the percentage expression in the News texts mathematically (Table 3). Contrary to expectations, students encountered a similar level of difficulty across all three context types.

Table 3

Findings Related to Students' Responses to the Tasks

Tasks	correct		Partially correct response		Incorrect response		Blank response
	Correct response						
	Giving daily life examples	Procedural	Approximate value	Giving daily life examples	Focusing on numerical increase/decrease	Incorrect response	Blank anwer

Results of the responses to tasks with a percentage value between 1 and 100

Tasks	Giving daily life examples	Procedural	Approximate value	Giving daily life examples	Focusing on numerical increase/decrease	Incorrect response	Blank anwer
1	S2, S15	-	S7	-	S6, S4, S9, S10, S11, S13, S14, S16, S18, S19, S20, S22, S25, S28, S29	S3, S17, S27, S30	S1, S5, S8, S12, S21, S23, S24, S26
Total	2	-	1	-	15	4	8
2	S2	S30	-	-	S1, S4, S6, S7, S9, S11, S12, S13, S14, S16, S17, S18, S19, S20, S23, S28, S29	S3, S8, S22, S26, S27	S5, S10, S15, S21, S24, S25
Total	1	1	-	-	17	5	6

Results for the responses to the tasks with more than 100 percentages value

Tasks	Giving daily life examples	Procedural	Approximate value	Giving daily life examples	Focusing on numerical increase/decrease	Incorrect response	Blank anwer
Total	S2, S3, S4, S7	-	S18	-	S6, S8, S9, S10, S11, S12, S13, S14, S15, S16, S17, S19, S20, S21, S22, S23, S24, S25, S27, S28, S29	S5, S30	S1, S26,
Total	4	-	1	-	21	2	2
4	S3	-	-	S2, S7, S15	S4, S6, S9, S10, S11, S12, S13, S14, S16, S19, S20, S21, S22, S24, S25, S26, S27	S5, S8, S17, S18, S29, S30	S1, S23, S28
Total	1	-	-	3	17	6	3

Results for the responses to tasks with a percentage value between 0 and 1

Tasks	Giving daily life examples	Procedural	Approximate value	Giving daily life examples	Focusing on numerical increase/decrease	Incorrect response	Blank anwer
5	S3, S6	S4	-	-	S1, S5, S12, S30	S2, S7, S9, S11, S13, S14, S15, S17, S18, S19, S20, S21, S22, S24, S25, S27, S28, S29	S8, S10, S16, S23, S26
Total	2	1	-	-	4	18	5
6	-	S4	-	-	S1, S2, S3, S23, S30	S5, S6, S7, S8, S9, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S22, S29	S10, S21, S24, S25, S26, S27, S28
Total	-	1	-	-	5	17	7

The results obtained from the tasks containing percentage expressions between 1 and 100 show that, in the first task, 2 students provided the correct response with a daily life example and 1 student provided a partially correct response by reaching an approximate response; in the second task, 1 student provided a daily life example and 1 student provided a procedural example. It is seen that the majority of the students focused only on the numerical increase or numerical decrease in the percentage expression in the News text or provided irrelevant, incomplete or blank responses. The results obtained from the tasks with a percentage value greater than 100 shows that, in the third task, 4 students provided a correct response with a daily life example, 1 student provided a partially correct response by reaching an approximate response, and in the fourth task, only 1 student reached the correct response by giving a daily life example. Similarly, the rest of the students focused only on the numerical increase or numerical decrease in the percentage expression in the News text, or provided irrelevant, incomplete or blank responses. In cases involving

percentages less than 1, it is seen that in the fifth task, 2 students provided the correct response with a daily life example and 1 student reached the correct response by giving a procedural example; in the sixth task, only 1 student reached the correct response by giving a procedural example. The remaining students, who were unable to concentrate on the numerical increase or decrease as in the other tasks, typically provided irrelevant or blank responses.

As an example, the sample student response in Figure 1 provided a number exceeding 100 and stated that it increased to 290. In actuality, he provided the correct response by elaborating on his initial remark and stating that it was nearly three times greater.

Figure 1.

First Sample Student Response to the Task with more than 100 Percentages Value
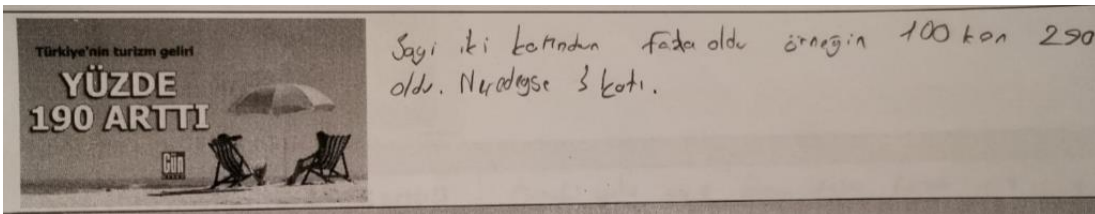
Translation: The number more than doubled, for example, from 100 to 290

Some of the students provided examples from daily life. For example, for the context "Turkey's tourism income increased by 190 percent", a student wrote a comment as "I understand that if 100 thousand people come to a country for tourism, 190 thousand more people come". And several students arrived at the correct response solely through numerical calculations without using examples from daily life. Some of the students appeared to be treating the percentage value in the situations as a number. For example, in the context of "Turkey's tourism income increased by 190 percent", comments such as "190 Turkish Liras more income was added to Turkey's tourism income" were found (Figure 2). Additionally, it was found that most students commented on an increase or decrease, as in the phrases "There has been an increase in reading level," "There has been an increase in house sales," or "There has been a raise."

Figure 2.

Second Sample Student Response to the Task with more than 100 Percentages Value
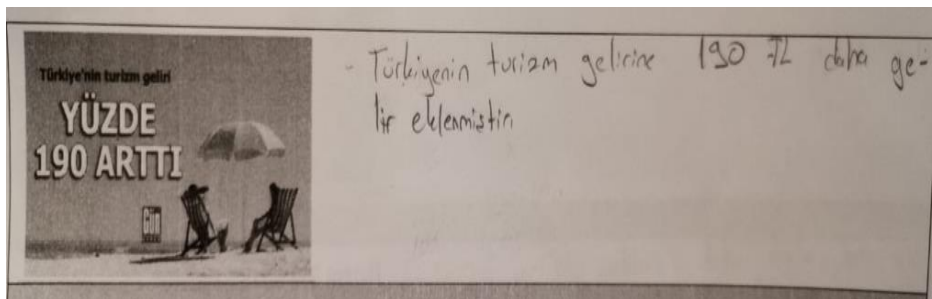
Translation: Another 190 Turkish liras were added to Turkey's tourism income.

As seen in Figure 3, S13 did not address the task mathematically at all (%0.6) and focused solely on the word 'decrease' providing an example of the decrease in exports.

Figure 3.

A Sample Student Response to Task with a Percentage Value between 0 and 1
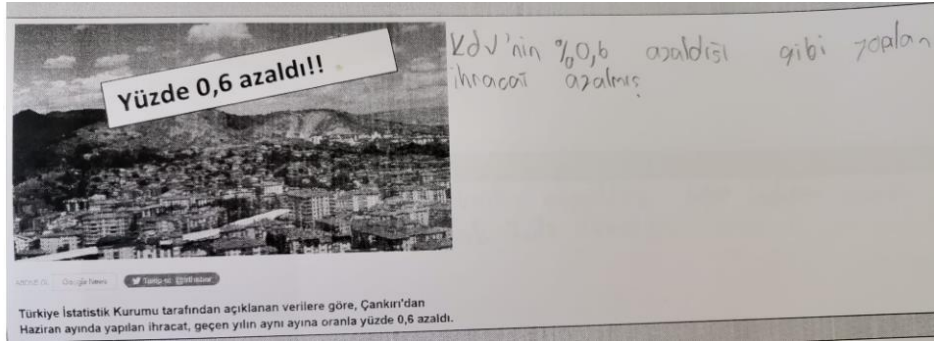
Translation: Exports decreased by 0.6%

In Figure 4, the student interpreted the increase in the reading rate as 'the number of readers has increased' instead of mathematically understanding what a 1000 percent increase entails.

Figure 4.

Third Sample Student Response to the Task with more than 100 Percentages Value
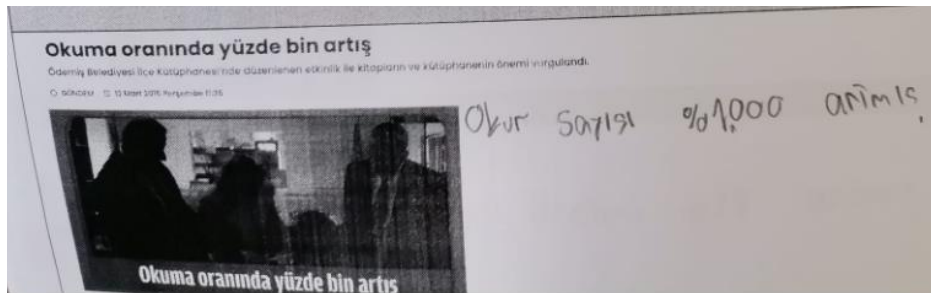
Translation: The number of readers increased by a thousand percent

In addition, irrelevant comments such as "I think it should have increased a little more", "It has increased too much", "They should decrease" as well as blank answers, are noteworthy results obtained from the study.

Discussion, Conclusion & Suggestions

Problems with daily life contexts have an important potential for students to make sense of mathematics by associating it with daily life. Based on this potential, context examples of actual real life situations were used in this study. Within the scope of the study, student comments on News texts containing percentage representation were analyzed. According to the results, students had difficulty in understanding the daily life contexts containing percentage representation and interpreting the context clearly and comprehensibly. Very few students were able to interpret the contexts by connecting them with daily life. For example, for the context "Turkey's tourism revenue

increased by 190 percent", a student wrote a comment such as "I understand that if 100 thousand people come to a country for tourism, 190 thousand more people come". Mathematics is more than a mechanical structure in which students are taught a set of rules and procedures, it requires the integrity of meaning in which students make sense of what they learn and build on previous learnings. Associating mathematics with daily life allows this structure to be built on more steady foundations (MoNE, 2013; National Council of Teachers of Mathematics [NCTM], 2000; OECD, 2012; Singletary, 2012). As a matter of fact, the international exam organization PISA measures the extent to which 15-year-old students can use the knowledge and skills they learn at school in daily life (Ministry of National Education [MoNE], 2020; OECD, 2012). The results obtained in this study indicate that students encounter significant challenges when attempting to relate the concept of percentage to everyday life.

Mathematical literacy has an important role when it comes to making connections with daily life. In this context, the results related to understanding the basic understanding underlying the context-based percentage expressions and thinking flexibly, which were asked in the study, gain importance. Students could not interpret real-life situations involving percentage expressions correctly. It was concluded that the majority of the students made comments focusing on increase or decrease, as in the expressions "There has been an increase in reading level", "There has been an increase in house sales", "There has been a raise", and produced blank or irrelevant solutions. This may be attributed to the students' inadequacy in explaining themselves and their lack of conceptual understanding of the percentage. As a matter of fact, students mostly tried to reach the answer by making only numerical calculations without establishing a relationship with daily life. For example, for the context of "Turkey's tourism income increased by 190%", comments such as "190 Turkish Liras more income was added to Turkey's tourism income" were found in the study. In many studies conducted in the literature, it was observed that students tended to apply procedural algorithm rather than conceptual understanding of percentage expressions (Gay, 1990; Van Den Heuvel-Panhuizen, 1994). In addition, it is understood that students mostly perceive percent representation as an integer. In line with the findings of this study, Erdem, Özçelik, and Gürbüz (2018) similarly concluded in their study on percentage expressions that students tend to hold misconceptions by perceiving the concept of percentage as a whole number.

In this study, students were expected to interpret three different types of contexts, each of which contained two tasks with percentage values ranging from 0-1, 1-100, and more than 100. Prior to the study, the researchers hypothesized that students wouldn't have much trouble in situations where the percentage value ranged from 1 to 100. However, regardless of the context type, students consistently made the same mistakes and got similar results. It demonstrates that students who understood the notion of percentage performed well in a variety of situations. This finding demonstrated that students face difficulties in understanding percentages regardless of the context type. Numerous studies in the literature have shown that students struggle in different ways with percentage (Özçelik & Tutak, 2017; Lestiana, 2021; Parker & Leinhardt, 1995).

According to the findins, we made some recommendations for teachers and researchers. Daily life examples or News texts might be often used while introducing the concept of percent in maths lessons to avoid students approaching it procedurally. In school textbooks and curricula, examples that will associate the concept of

percentage more with real life can be emphasized. Additionally, teaching percent expressions by connecting them to these concepts—beginning with rational numbers, fractions, and decimal fractions—can support in comprehending how percent expressions differ from integers. This could help dispel the myth that percent expressions exist in a whole different realm than rational numbers or fractions, dispelling misconceptions about them. Last but not least, emphasizing the part-whole relationship and the ratio relationship between two variables while discussing percent expressions in mathematics lessons can give students the impression that percent expressions are different from natural numbers and integers.

Ethic

We declare that the research was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Author Contributions

This article was written with the joint contributions of four authors.

Conflict of Interest

The authors declare that they have no conflict of interest.

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The Effect of Mathematics Difficulty Intervention Programs on Mathematics Performance: A Second-Order Meta-Analysis

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Abstract

Determining and evaluating the effects of mathematics difficulty intervention programs designed for students with MD are important for guiding teachers, researchers, and policy-makers. In this context, this research examines the influence of MD intervention programs on students' mathematical performance. Between 2009 and 2022, a total of 13 meta-analytical studies have been conducted. The research is currently exploring the consequences of intervention efforts on students diagnosed with MD for this objective. The analysis of this effect size value employs a second-order meta-analytical approach. Upon concluding the analysis process, it has been determined that the effect of MD intervention programs on students' mathematical performance is of moderate magnitude (ES = 0.70). Further, it is found that the location that MD intervention programs comprise, publication period, and features of participants are variables that cause meaningful differences in students' mathematics performance. According to the study results, types of the program and school level are variables that do not cause any meaningful difference. However, the program of EI intervention has an important effect on the mathematics performances of individuals with MD. Obtained results and directions for forthcoming studies are discussed in the scope of this study.

Key Words

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Introduction

Mathematics difficulties (MD) affect the process of learning arithmetical skills. Students with MD could potentially encounter challenges comprehending basic numerical concepts, and arithmetical operations, and they might not have the intuition to comprehend numbers (Kelly, 2020). MD is a mathematical inefficacy that affects learning the concept of numbers, basic mathematical operations, articulation, and accurate and fluent calculation processes (American Psychological Association [APA], 2013). Moreover, the concept of Mathematics Disability (MD) is delineated as a condition characterized by suboptimal mathematical performance attributed to various factors, including inadequate learning, limited cognitive development, and sociocultural influences, as outlined by the American Psychological Association (APA, 2013).

Different use of terminology in research makes it difficult to compare and evaluate research results. While the term "mathematics difficulty" is commonly used in the USA, the term "dyscalculia" is preferred in the UK and Europe (Kelly, 2020). It can be said that the target research included in this study focus on students with some specific difficulties in mathematics (learning difficulty, dyscalculia, children with low performance, dyscalculia risk). On the other hand, as identification criteria used for determining participant students vary according to studies, the term "mathematics difficulty" is used in this study. Students with the risk of failure in mathematics, students diagnosed as "having difficulty in math", and students with low mathematics success are the groups that have the problem of MD (Geary et al., 2007).

It is reported that the frequency of MD in the UK is approximately 5% (Kelly, 2020). A similar ratio is determined (5, 7%) in a study including the evaluation of 2461 primary school students based on DSM-5 diagnosis criteria (Morsanyi et al., 2018). In their research, Butterworth et al. (2011) documented a prevalence rate ranging from 5% to 7% for math difficulties. When these values are taken into consideration, it can be said that the observed frequency of MD varies between 5-6% (Kaufmann & von Aster, 2012). Based on data derived from the year 2015, it was observed that in the global context, over 55% of adolescents enrolled in primary and secondary educational institutions fell short of attaining the minimum proficiency standards in both reading and mathematics, as reported by the United Nations (UN, 2018). On the other hand, according to the 2019 NAEP mathematics score assessments, both 8th graders (66%) and 12th graders (76%) did not reach the minimum proficiency standards in mathematics (NAEP, 2019). Reports indicate that individuals have difficulties in learning and performing math.

Mathematical skills have critical importance in individual life (Nelson & Powell, 2018). It can thus be said that low arithmetical skills might affect school success, spiritual well-being, and confidence of individuals (Fritz et al., 2019). Furthermore causes losing various job opportunities in the future. On the other hand, individuals who have these difficulties might not have the chance to carry out some daily activities in life (Benavides-Varela et al., 2020). This is why; math education should be presented to individuals with mathematics difficulties through efficient interventions that increase their success (Myers et al., 2021).

Students with MD have problems with basic and advanced mathematical concepts (Myers et al., 2021). These students are less successful with the concept of numbers and calculation skills throughout the primary school education process when compared to their peers with no mathematical problems (Stock et al., 2010). It is observed

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that the disparity between students with MD and their peers widens as they progress through higher grade levels. The phenomenon referred to as a cumulative deficiency manifests as an inability among students with Mathematics Disability (MD) to precisely apprehend the presented educational content (Bender, 2016). The complexity of the mathematics learning process intensifies as students transition from primary to middle school (Myers et al., 2021). Deficient learning that couldn't be removed during primary education might increase the problems that these students experience and have permanent impacts on mathematics success (Witzel & Little, 2016). When students with MD aren't supported with additional courses and educational intervention programs, they continue to stay behind their peers who have typical development (Wei et al., 2013). It becomes evident that the difficulties faced by these students persist and impact their achievements in fractions, algebra, and ratios (Powell et al., 2021).

Experimental studies focused on intervention programs have indicated that enhancing the mathematical learning outcomes of individuals with MD is feasible (Aunio et al., 2021; Wu et al., 2020). Furthermore, meta-analysis studies suggest the existence of various educational intervention programs designed for individuals with MD (Myers et al., 2022). In these studies, it is determined that such intervention programs support students' mathematical learning processes. Researchers reported some efficient intervention programs such as cognitive-based instruction, technology-based instruction, concrete representation abstract instruction, schema-based instruction, peer-assisted instruction, and explicit instruction. Both researchers and practitioners frequently appeal to meta-analyses for efficient educational interventions that can be used for students with Learning Disabilities (LD). In this regard, it can be noted that there has been an increase in the quantity of meta-analysis dedicated to students with MD, and they have been increasingly employed within the field (Nelson et al., 2022).

There are some recent meta-analysis studies about MD students and the efficiency of mathematics intervention programs on their learning abilities (Myers et al., 2022; Ran et al., 2021). In the course of these investigations, scholars computed a range of effect sizes, exhibiting variations from moderate to relatively substantial, with values spanning from g=0.57 to g=0.71. Different effect sizes indicate that there are differences in the impacts of mathematics intervention programs. The reason behind these effect sizes might be the differences between inclusion criteria. For instance, Myers et al. (2022) analyzed mathematics intervention programs designed for increasing the performance of problem-solving achievement of students with MD. Based on the findings from 36 intervention studies, there is a substantial and favorable effect size (g = 0.71).

Meta-analysis studies in the literature give important information about the efficiency of intervention programs developed for students with MD. However, different definitions of variables, study groups, and intervention groups make it difficult to reach an absolute result. Myers et al. (2022) concentrated exclusively on the problem solving abilities of individuals with MD, encompassing grades 4 through 12. They also analyzed studies that involve a specific age range. The researchers partially alluded to efficacious intervention programs targeting students at the primary school level. It can be said that there is a need for a detailed analysis that involves all education levels. Myers et al. (2021) analyzed interventions designed for increasing the academic performance of individuals with MD at the secondary school level in a math lesson. Interventions targeting primary and high school students with MD are excluded. Ran et al. (2021) centered their research on the effect of computer technology on mathematics

achievement. Nonetheless, it is imperative to create distinct intervention programs specially to the requirements of these students. As students with MD are heterogeneous, different intervention programs that serve their specific needs and features are necessary. Jitendra et al. (2020) exclusively reviewed Tier 2 interventions; so other intervention programs that are efficient in teaching mathematical subjects to students with MD are excluded from the study. Jitendra et al. (2018) used cutoff scores to determine students with MD (students with scores lower than the 35 percentile). Although the cutoff score is common (Mazzocco, 2007), the use of specific scores in analyses might exclude students with MD. For instance, 10 and 50 percentiles are commonly used to determine students with MD risk (Nelson & Powell, 2018). A more comprehensive cutoff score can be determined to analyze students with MD risk.

It is necessary to design and implement high-quality and efficient education for students with MD to complete and support mathematics education (Myers et al., 2021). It holds significance to comprehend and assess the effects of interventions developed for individuals with MD on their mathematical succes. It is necessary to make a comprehensive synthesis by taking articles and grey literature into consideration.

When the literature is analyzed, it is determined that there is not found second-order meta-analysis focusing on intervention programs designed for growing the mathematics performance of individuals with MD. In this regard, it can be asserted that a second-order meta-analysis is indispensable for the critical assessment and evaluation of primary studies, thereby facilitating the determination of the effectiveness of intervention programs. Within the scope of this study, the aggregation and assessment of effect sizes derived from first-order meta-analyses yield more precise estimations. Additionally, second order meta analysis involves the assessment of the quality of first order meta analysis. Thirdly, the identification of effective intervention programs that enhance the mathematical performance of individuals with MD is expected to actually benefit the practices of policy-makers, researchers, and educators. Fourthly, it was determined if intervention programs meaningfully varied in terms of moderator variables (publication year, location, grade, intervention program, participant characteristics, and quality).

The core aim of this research investigation is to evaluate the influence of intervention initiatives developed for students with MD on their performance in mathematics. Furthermore, the effects of moderator variables (grade, location, report type, intervention, quality, and participants' characteristics) on the academic success of students with MD are another basic focus of the study. In this context, the aim of this study is to examine the influence of intervention programs for MD on the academic achievement of students. The below-mentioned questions are asked and analyzed for this purpose.

1. To what extent do MD intervention programs affect mathematics performance?

2. Do moderator variables influence the impact of MD intervention programs on mathematics performance?

Method

Research Design

In this research, the utilization of the second-order meta-analysis methodology is undertaken to scrutinize the impact of Mathematics Disability (MD) intervention programs on the mathematical performance of individuals. This

method closely parallels the approach of first-order meta-analysis. The studies subjected to second-order meta-analysis processes are, in fact, meta-analysis research studies (Polanin et al., 2017). Essentially, a second-order meta-analysis is a technique used to amalgamate the results of first-order meta-analysis research (Schmidt & Oh, 2013). In simpler terms, it involves analyzing the findings of meta-analyses.

Data Collection

Data from the research is collected by using Wiley, Web of Science, Taylor & Francis, Sage Journals, Science Direct, and Scopus databases. A detailed electronic search is carried out by using these specific databases. The predetermined keywords are used while carrying out searches. In the first line of search, the keywords "learning difficulties/disabilities", "mathematics learning difficulties", "mathematics difficulties", "dyscalculia", "low achievement" and "low performance" are used. In the second line, "intervention", "instructional intervention", "mathematics intervention", "mathematics instruction" and "instruction strategies" keywords are used; and in the third line, "meta-analysis" and "systematic review" keywords are used.

On the other hand, manual searches were carried out in important journals in the LD literature. The data of the studies included in the research vary between 2009 and 2022. Since the oldest study included in the research was published in 2009, this year was preferred as the starting year of the screening.

At the end of the search procedure, a total of 143 studies are determined in the first phase. After this process, the studies that aren't relevant or repeat one another are excluded (n=46). In the next step, the reviewed studies are carefully analyzed according to their abstract section and the ones that aren't relevant are excluded (n=53). The full-text articles that are evaluated in terms of appropriateness are analyzed by considering inclusion and exclusion criteria (n=44). Out of these full-text articles, the ones that do not involve mathematics intervention (n=13), do not involve mathematics difficulty (n=8), proper statistical data (n=4), and overlapping studies (n=6) are excluded. The full-text articles that meet the criteria (n=13) are included in the second-order analysis. The review process is presented in Figure 1 with a PRISMA diagram.

Figure 1.

Data Collection Process
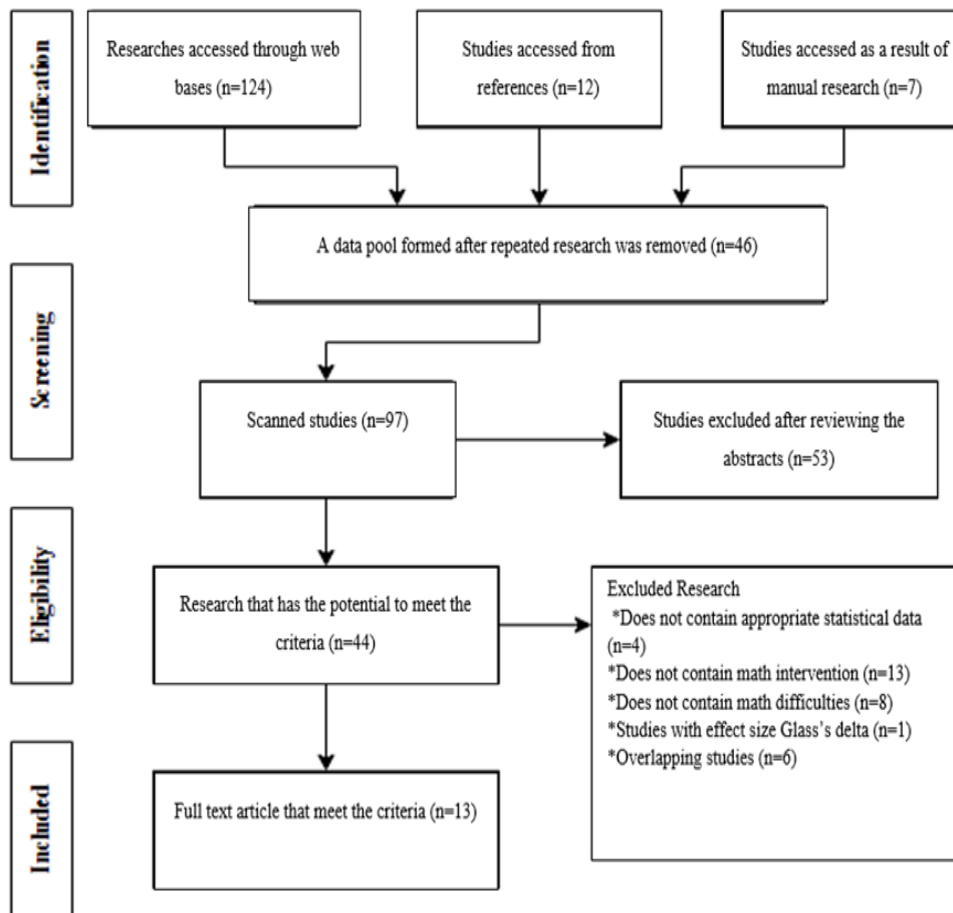
Inclusion Criteria

The following criteria were used for the studies included in the analysis:

1. The purpose of the research should be to analyze the effect of an intervention program developed for individuals with MD on their mathematics performance.
2. The intervention program used in the research should be clearly stated.
3. The participant group of research should include students diagnosed with LD and MD and students with MD risk.
4. Studies should have been published in 2009 and 2022 in English.
5. Studies should include statistical data sufficient for calculating effect size. The included studies and their characteristics in Table 1.

Table 1.

Included Studies and their Characteristics

Study	ES	LL	UL	k	Grade	Location	Report Type	Intervention	Quality	Bias	Year Range	Classification of the Participants
	1,22	0,80	2,15	11				EI				
Gersten et al. (2009)	0,47	0,25	0,70	12	K12	Global	Mixed	VR	High	Small	from 1971 to 1999	LD and MD
	0,14	-0,09	0,32	6				PAI				
Zhang, & Xin (2012)	2,63	1,96	3,31	16				EI	High			
	1,85	1,07	2,63	12	K12	Global	Mixed	CBI	High	NA	from 1996 to 2009	MD
	1,21	0,62	1,81	20				TBI	Median			
	0,50	0,30	0,70	10				EI				
Chodura, et al. (2015)	1,04	0,93	1,16	11	Elementary	Global	Article	CBI	High	No	-	At risk MD
	0,99	0,48	1,50	14				TBI				
	0,76	0,45	0,94	18				EI				
Dennis, et al. (2016)	0,82	0,42	1,22	4	Elementary	Global	Article	PAI	Median	NA	from 2000 to 2014	At risk MD
	0,39	0,15	0,64	9				TBI				
Jitendra, et al. (2016)	0,68	0,43	0,92	25	K12	Global	Article	VR	High	NA	Up to 2014	At risk MD
Stevens, et al. (2018)	0,85	0,56	1,14	25	K12	Global	Article	EI	High	No	from 1990 to 2015	MD
Küçükalkan,et al. (2019)	0,60	0,48	0,72	33	K12	Global	Mixed	CBI	Median	No	from 2007 to 2018	MD
Lein, et al. (2020)	0,73	0,80	1,38	18	K12	Global	Mixed	SBI	High	No	from 1989 to 2019	At risk MD
	0,28	0,06	0,50	11				CBI				

Table 1.
Continue

Study	ES	LL	UL	k	Grade	Location	Report Type	Intervention	Quality	Bias	Year Range	Classification of the Participants
Benavides-Varela, et al. (2020)	0,55	0,19	0,90	15	K12	Global	Article	TBI	High	No	from 2003 to 2019	MD
	0,56	0,29	0,84	28				TBI				
Myers, et al. (2021)	0,45	0,10	0,79	11	Secondary	USA	Mixed	VR	High	No	from 1978 to 2020	At risk MD
	0,31	-0,03	0,65	6				SBI				
	0,17	-0,07	0,42	4				PAI				
Ran, et al. (2021)	0,39	0,04	0,74	28	K12	Global	Article	TBI	High	No	from 2010 to 2018	At risk MD
	0,86	0,46	1,26	9				CBI				
Myers, et al. (2022)	1,18	0,86	1,50	29	Elementary	Global	Mixed	SBI	High	No	from 1992 to 2021	At risk MD
	0,71	0,22	1,20	17				CBI				
Dennis, et al. (2022)	0,49	0,38	0,64	44	Elementary	USA	Article	CBI	Median	NA	from 2005 to 2019	At risk MD

Interventions= CBI: Cognitive Based instruction; EI: Explicit Instruction; PAI: Peer-Assisted Instruction; SBI: Schema Based Instruction; TBI: Technology Based Instruction; VR: Visual Represantation, ** Classification of the Participants = MD: Mathematic Difficulties; LD: Learning Difficulties

Exclusion Criteria

Studies are excluded if they have the below-mentioned characteristics.

1. Studies that analyze an output different from the impact of developed educational intervention on mathematics performance (motivation, perception, etc.).
2. Studies with participants that are diagnosed with disabilities other than LD, MD, and/or MD.
3. Studies that have scores below 23 on the R-AMSTAR scale which is used for publication quality.
4. If Cooper and Koenka (2012) overlapping ratio of studies is below 25%, this indicates that the meta-analysis study is independent. If the overlapping ratio of meta-analysis studies is over 25%, current and more comprehensive meta-analyses are chosen and the other is excluded.

Overlapping Problem

One of the challenges inherent in second-order meta-analysis research pertains to issues of overlap, whereby multiple meta-analyses encompassing identical primary research studies are encountered. The task of conducting an analysis to identify and account for such overlap in this study has been undertaken by the first and second authors, and the resultant report of the overlapping analysis is delineated in Table 2.

Table 1.

Overlapping Analysis

Studies		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Benavides-Varela et al. (2020)	1	-																	
Chodura et al. (2015)	2	13	-																
Dennis et al. (2016)	3	7	12	-															
Dennis et al. (2022)	4	33	8	52	-														
Gersten et al. (2009)	5	-	-	-	-	-													
Jitendra et al. (2018)	6	-	-	-	30	-	-												
Kong et al. (2021)	7	-	-	27	27	-	-	-											
Küçükalkan et al. (2019)	8	-	-	-	9	-	-	-	-										
Lein et al. (2020)	9	-	4	15	33	-	-	-	-	-									
Myers et al. (2021)	10	-	-	-	14	-	60	-	-	10	-								
Myers et al. (2022)	11	-	-	-	-	-	-	-	-	-	-	-							
Ran et al. (2021)	12	-	-	-	-	-	-	-	-	-	-	-	-						
Stevens et al. (2018)	13	-	-	-	-	-	-	-	-	-	-	-	-	-					
Zhang & Xin (2012)	14	-	-	8	7	-	-	-	-	22	17	-	-	-	-				
Jitendra et al. (2016)	15	-	8	12	20	-	-	-	-	16	12	-	-	-	12	-			
Peltier & Vannest (2017)	16	-	-	33	28	-	28	-	-	-	-	-	-	-	-	-	-		
Shin & Bryant (2015)	17	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	-	
Zheng et al. (2013)	18	-	-	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-

Note= *Italicized studies are excluded from the analysis due to overlap.*

Coding: The selected research is coded based on the issues mentioned below, and this coding is performed by both the first and second authors. The consistency of coding between the two authors is assessed using the reliability formula proposed by Miles and Huberman (1994). Coherence between coders is calculated to be .93. Codes that aren't coherent are discussed by all of the authors and the final decision is accordingly made.

Intervention program: Previous studies on the issue are taken into consideration in this study while encoding the intervention programs (Myers et al., 2015). Intervention programs are encoded in 6 different titles. Criteria that are taken into consideration while encoding intervention programs are presented below.

(a) Technology-Based Instruction (TBI): Studies based on computer-supported teaching and video-supported education.

(b) Cognitive Based Instruction (CBI): Studies that involve the use of articulation strategies for problem-solving, self-follow-up strategies and remembering which are cognitive or meta-cognitive.

(c) Schema-Based Instruction (SBI): Studies that are either based on scheme or scheme broadening (and transfer) instructions (Jitendra et al., 2018),

(d) Explicit Instruction (EI): When special education literature is analyzed, it can be seen that there is a general understanding that mathematics teaching should be open and systematic (Gersten et al, 2001; Swanson & Hoskyn, 1998). On the other hand, the terms should be used to define some teaching approaches (Gersten et al., 2009). To remove any misunderstandings, studies that have three components are encoded as open education (Gersten et al., 2009): (i) the teacher presents a step-by-step plan to solve the problem, (ii) the presented plan is specific for a series of problems and (iii) students use the plan presented by the teacher to solve the problem.

(e) Visual Representation (VR): Studies that involve concrete (for ex. manipulative), semi-abstract (for ex. pictures and diagrams), and abstract (for ex. symbols) representations in teaching mathematical concepts. These representations should be used by either teacher or student while solving problems to be able to encode the study visually.

(f) Peer-Assisted Instruction (PAI): Studies based on the learning process through cooperation among students are coded under this title. In peer-supported teaching, students not only carry out their learning activities but also they are responsible for learning how to work together with peers in group activities and how they should ask for help when needed (Polloway et al., 2013).

Participant characteristics

Students might have difficulty in learning mathematics; however, this situation doesn't mean that they have mathematics difficultyStudents afflicted by mathematics difficulties constitute a heterogeneous cohort characterized by challenges in the realm of mathematics (Nelson & Powell, 2018). In this respect, there is not a single common idea about defining students with MD (Myers et al., 2021). Students with MD are diagnosed with Legal Difficulty (LD) and have mathematics goals in the scope of an IEP (Individualized Education Program) (Myers et al., 2021).

Besides students with legal diagnoses, some students don't have a legal diagnosis but have low mathematics performance and MD risk. These students struggle to learn mathematics all the time (Swanson et al., 2015). They are regarded as students with MD risk according to the cutoff score (Nelson & Powell, 2018). Cutoff scores used for students with MD risk commonly vary between 10. and 50. percentiles (Myers et al., 2022; Nelson & Powell, 2018).

During encoding, the term "students with MD" is used when there is a classification according to ICD-10 (WHO, 2005) or DSM-5 (APA, 2013) criteria. The same terms are also used for students who have determined mathematics goals in the scope of IEP. The term "students with MD risk" is used by researchers for students who are between 10. and 50. percentiles in a standard mathematics test (Chodura et al., 2015; Möller et al., 2012). This situation might represent a heterogeneous group that also comprises students with MD. However, because of the lack of information in meta-analyses, it wasn't possible to distinguish these groups. The term "students with LD" is additionally used as there are meta-analysis studies that comprise children who have problems more than simply mathematics difficulties. Students who have been formally diagnosed with Learning Disabilities (LD), as well as those encountering impediments in their mathematical learning, fall within the classification of students with LD.

Meta-analysis Quality Level

In this study, the evaluation of the quality of the meta-analysis research is conducted using the Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) scale, which was revised by Kung et al. (2010). Scores ranging, from 0 to 11 are categorized as "insufficient.", from 12 to 22 fall under the "low", from 23 to 33 are considered "medium", from 34 to 44 indicate a "high" level of quality (Young, 2017). Notably, items 8C and 8D in the R-AMSTAR scale, originally developed for clinical practice, are not utilized in this research. Instead, items 8A and 8B are combined and treated as a single score. The quality assessment process involves the first and second authors, and the average of their scores is considered the quality score. Subsequently, these quality scores are categorized according to the assessment ranges described above.

Academic performance: Mathematics success and mathematical ability of students are encoded as "mathematics performance".

Grade level: Researches are encoded as "K12", elementary and secondary according to the education levels in the studies they involve.

Bias status: Publication bias analyses of the research are analyzed and encoded as "trivial, small, and NA" (not available) according to the style they are reported in the publication. Research that does not have reports of publication bias is encoded as "NA".

Location: If the data of meta-analysis research involve various countries, they are coded as "global". If they include a single country, it is coded as "according to the country".

Report type: If the data of meta-analysis research involve only articles, they are encoded as "the article". If they include an article, a doctorate thesis, and others, they are encoded as "mixed".

Year Range: This study comprises 14 years. This is why; research is separated into two periods. The research process involves years between 2009 and 2022.

Statistical Independence

If meta-analysis researches involve more than one MD intervention program, they are encoded as "independent programs". For instance, in their research study, Dennis, et. al. (2016) represented three different effect sizes in EI, PAI, and TBI programs. This research comprises k=27 effect size obtained from n=13 meta-analysis research.

Selection of Effect Size

Meta-analysis researchers reported effect size indexes reported k=8 effect size as Cohen d and k= 19 as Hedge's g. Hedge's g and Cohen d value calculation formulas are different from one another. However, Hedge's g and Cohen's d calculations give the same value in big samplings. On the other hand, Hegde's g value is the corrected value of Cohen d for small samplings (Marfo & Okyere, 2019; Turner & Bernard, 2006). In essence, it can be postulated that, for sufficiently large sample sizes, the effect size denoted as "g" approximates equivalence to "d." Samplings are regarded to be big enough in this research. There is a similar acceptance in different second-order (Hew et. al., 2021)

Statistical Model for Analysis

The utilization of the random-effects model is recommended when the effect sizes being analyzed in meta-analytical statistical analyses are derived from different samples or when the research studies providing the effect sizes exhibit significant variability (Borenstein et al., 2011). In this research, the random-effects model has been chosen for these specific reasons. Heterogeneity analyses of the mean effect size are conducted using the random-effects model to account for potential variability among the included studies.

Publication Bias

Reliability of the produced mean effect size is closely related to publication bias. There are many publication bias techniques in the literature (Mathur et al., 2021). In this research, publication bias analyses of the dataset incorporate several techniques, including funnel plot graphic analysis, Egger's test, and the Duval & Tweedie trim and fill analysis, as outlined by Jin et al. (2015).

Heterogeneity Analysis

Intra-group and inter-groups heterogeneity analyses are carried out according to Q statistical technique. In other words, the Q total (Qt) is calculated total heterogeneity amount while Q between (Qb) value is calculated for the between-groups heterogeneity amount. Conversely, the I^2 value is computed to assess the degree of heterogeneity among groups. (Huedo-Medina, et. al, 2006).

Results

Findings about the effect size of the dataset, total heterogeneity amount, and level are first presented in this section of the research study. Secondly, the results of the publication bias analyses are discussed. Thirdly, moderator analysis and inter-group heterogeneity analyses are presented.

Effect Size and Total Heterogeneity

The dataset involves k=27 effect sizes independent from one another. Effect sizes vary between ES=.14 and ES=2.63. The effect of MD intervention programs on students' mathematics performance is calculated as ES=.70 LL=.56 UL=.83. In other words, the effect of MD intervention programs on students' mathematics performance is medium-level. The heterogeneity amount of the dataset is Qt=183.34 p< .01; the heterogeneity level is I^2=85.82. It is observed that the dataset is highly heterogeneous.

Publication Bias Analyses

Upon analyzing the Funnel Plot graphic, it becomes evident that the distribution of effect sizes in relation to the standard error is symmetrical. Figure 2 illustrates the Funnel Plot graphic of the dataset. Likewise, the results of Egger's regression test indicate that there is no statistically significant publication bias (t = 0.92, p = 0.36). Furthermore, when the Duval & Tweedie trim and fill analysis is conducted, it is determined that no additional studies need to be added (k = 0). In summary, based on the outcomes of the publication bias assessments and their corresponding analyses, it is reasonable to deduce that the dataset under scrutiny does not manifest discernible indications of publication bias.

Figure 2.

Funnel Plot of the Studies
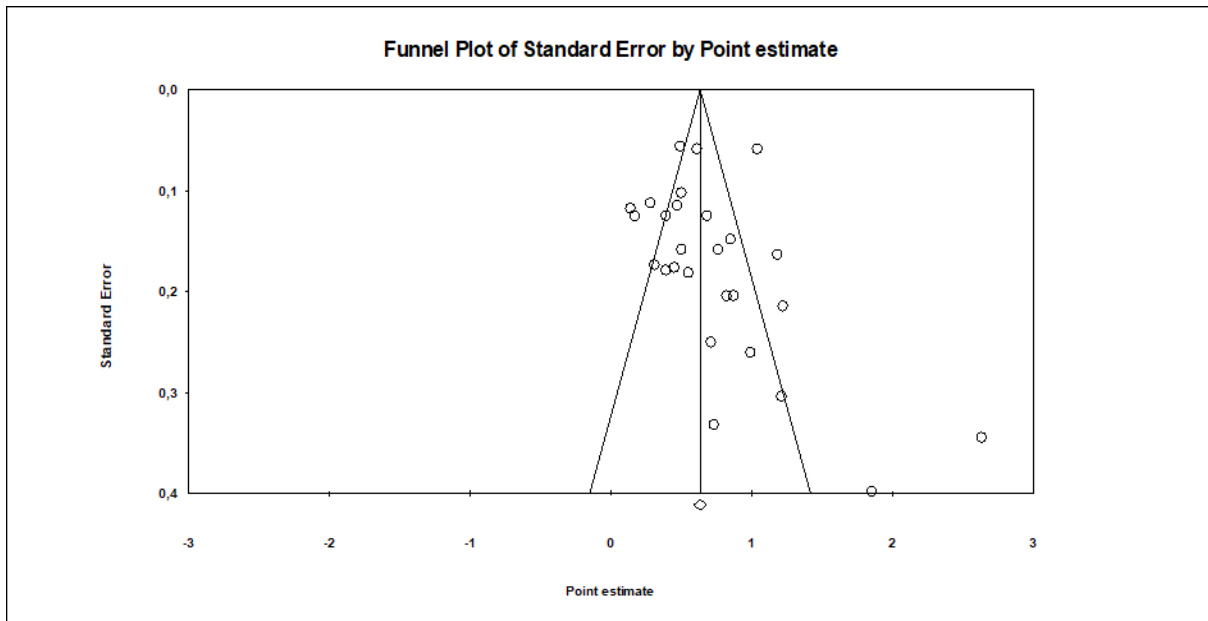
Moderators and Inter-Groups Heterogeneity Analyses

The results of the moderators and inter-group heterogeneity analyses for the dataset are displayed in Table 1. The findings obtained from these analyses are summarized below.

Table 2.

Data for Moderator and Heterogeneity Analysis

Group	K	ES	LL	UL	Qb	df (Q)	p
Intervention program							
CBI	7	.74	.48	1.00			
EI	5	1.03	.71	1.35			
TBI	6	.62	.32	.92			
SBI	3	.75	.32	1.18			
VR	3	.54	.15	.92			
PAI	3	.35	-.05	.74	8.40	5	.14
Participant characteristics							
At risk MD	18	.61	.44	.78			
MD	6	1.09	.77	1.42			
LD and MD	3	.56	.15	.97	7.23	2	.03
Grade level							
Elementary	9	.75	.52	.98			
Secondary	4	.35	.01	.69			
K12	14	.76	.57	.96	4.64	2	.10
Quality							
High	21	.71	.55	.87			
Median	6	.67	.38	.95	.06	1	.81
Report							
Article	12	.69	.49	.88			
Mixed	15	.71	.52	.90	.02	1	.88
Location							
Global	22	.77	.63	.92			
USA	5	.39	.09	.68	5.41	1	.02
Year range							
2009-2015	9	.94	.70	1.17			
2016-2022	18	.58	.43	.74	6.05	1	.01

*Interventions= CBI: Cognitive Based instruction; EI: Explicit Instruction; PAI: Peer-Assisted Instruction; SBI: Schema Based Instruction; TBI: Technology Based Instruction; VR: Visual Represantation, **Difficulties= MD: Mathematics Difficulties; LD: Learning Difficulties

Statistically, it has been found that the mean effect sizes vary based on the location of the meta-analysis research (Q (1) =5.41 p=.02). Meta-analysis research in the global group (that involves different countries) produce medium-level effect size while effect sizes from the USA produce low effect size (ES=.77 LL=.63 UL=.92; ES=.39 LL=.09 UL=.68 respectively). Additionally, there is a statistically significant variation in the mean effect sizes based on the publication date of the meta-analysis research (Q (1) =6.05 p=.01). Relatively early period meta-analysis researches between 2009 and 2015 have high-level effect sizes. On the other hand, relatively current meta-analysis researches have a medium-level effect size (ES=.94 LL=.70 UL=1.17; ES=.58 LL=.43 UL=.74 respectively).

It is determined that MD intervention programs' effect on mathematics performance varies according to participant groups. In other words, mean effect sizes statistically vary according to participant groups (Q (2) =7.23 p=.03). Impact of mathematics difficulty programs in student groups with MD is determined to be high while the impact on student groups with MD risk is medium (ES=1,09 LL=.77 UL=1.47; ES=.61 LL=.44 UL=.78 respectively).

The analysis reveals that mean effect sizes do not exhibit a statistically significant variation based on the type of intervention programs (Q (5) = 8.40, p = 0.14). Nevertheless, it is worth noting that the effect size of the EI program is significantly larger than that of the other programs (ES = 1.03, LL = 0.71, UL = 1.35). Conversely, the PAI program type yields a lower effect size than the others (ES = 0.35, LL = -0.05, UL = 0.74). Stated differently, the influence of the Educational Intervention (EI) program on students' mathematical performance appears to be substantial, while the Pedagogical Approach Intervention (PAI) program demonstrates a relatively lower effect. Meanwhile, the interventions denoted as Computer-Based Instruction (CBI), Teacher-Based Instruction (TBI), Student-Based Instruction (SBI), and Virtual Reality (VR) collectively exhibit effect sizes at a moderate level.

It has been determined that the mean effect size of the meta-analysis research does not exhibit a statistically significant variation based on the school level they encompass (Q (2) =4.64 p=.10). Secondary school effect size is low (ES=.35 LL=.01 UL=.69). It is found that it produced medium-level effect size for K12 and elementary levels.

Discussion, Conclusion & Suggestions

The findings of this study offer a quantitative summary of the influence of intervention programs tailored for students with MD on their performance in mathematics. The results of this second-order meta-analysis suggest that the intervention programs designed for students with MD effectively promote their success in mathematics. According to the findings of this study, MD intervention programs have positive and medium-level effect size on students' mathematics performance (ES = .70). This result suggests that students with MD derive benefits from the implemented intervention programs.

The Effect of MD Intervention Programs on Mathematics Performance

It is found that MD programs have a medium-level effect on students' mathematics performance in general. Besides, it is determined that among the MD programs, EI has a higher impact on students' mathematics performance. On the other hand, the PAI program has a low impact on performance. The EI intervention program has significantly influenced the mathematics performance of students with MD. The outcomes of this research align with the findings of other meta-analysis studies in the literature, as Gersten et al. (2009) indicated. The results obtained suggest that explicit ınstruction serves as a significant intervention program for instructing mathematics to students with MD.

In this study, it is determined that CBI, SBI, TBI, and VR intervention programs had a high-level effect on the mathematics performance of students with MD. When the obtained result is compared to the findings in the literature, it is observed that they are in parallel (Myers et al., 2022; Myers et al., 2021). CBI intervention program helps students with MD in choosing proper strategies, articulating problem-solving processes and evaluating the

solution, and using cognitive and meta-cognitive techniques during this evaluation (Iseman & Naglieri, 2011). The CBI intervention program has proven to be effective in enhancing the engagement of students with MD in the learning process and aiding in the development of problem-solving strategies, as indicated by Montague et al. (2014). Similarly, the TBI intervention program is efficient in terms of giving different opportunities such as repeating the learned information and instantly taking feedback (Kiru et al., 2018; Myers et al., 2021). Similar results are obtained in the studies that analyze the impacts of CBI and TBI intervention programs on the mathematics performance of students with MD (Myers et al., 2021). Similarly, a high level of impact is determined in previous studies about the SBI intervention program (Lein et al., 2020). However, Myers et al. (2022) calculated a slightly lower value for the SBI intervention program. Differences in statistical calculations might be the reason for this difference. Additionally, VR intervention programs contribute by attributing meaning to understanding abstract ideas and representing problems concretely at school (Gersten et al., 2009). These findings suggest that a variety of intervention programs may be viable options for the pedagogical instruction of mathematics to students afflicted with Mathematics Disability (MD). However, as students with MD are heterogeneous, it is necessary to make intervention studies that support different features of students.

The effect of PAI intervention programs on the mathematics performance of students with MD is low. Previous meta-analysis studies also support this finding (Gersten et al., 2009). It is determined that peer-supported teaching isn't successful in MD students' training when compared to the impacts of it on other students who have typical development (Gersten et al., 2009). Mathematics education of students with MD should be carried out by experienced and knowledgeable teachers (Cortiella & Burnette, 2008; Witzel & Little, 2016). In the peer-supported teaching process, peers of the student with MD have insufficient knowledge about the education of these students. Insufficient sampling might be another reason. More studies about peer-supported education and its efficiency can be analyzed (Gersten et al., 2009).

Teachers need to be knowledgeable about efficient intervention programs to increase the success of students with MD (Myers et al., 2021). Although these intervention programs are promising in terms of having more benefits in the teaching process, it is necessary to have different types of such programs as students have different characteristics.

Investigation of Mathematics Performance According to Moderator Variables

An efficient education process is necessary to enable MD students to benefit from the general mathematics curriculum efficiently and productively (Powell et al., 2013). However, it is reported that when in-class education is not efficient, MD students need a more intense intervention (Stevenson & Reed, 2017). It is necessary to make some arrangements to present a complementary intervention to students with MD. It is determined that there is an important amount of heterogeneity in the ES among studies.

It is determined that there is important heterogeneity in the ES between research studies. This finding is in parallel with the findings of previous studies (Jitendra et al., 2020; Myers et al., 2021; Stevens et al., 2018). To determine the resource of heterogeneity, it is studied to see if the impacts of intervention programs on mathematics performance vary according to moderator variables.

Participant Characteristics

In this study, it is determined that MD intervention programs had a meaningful difference according to the features of participants. In this respect, an effect size in favor of students with MD is calculated. The group of MD students in this research study is made of individuals who only have difficulty in mathematicsThe remaining groups may present supplementary challenges encompassing issues related to reading, attention, comprehension, and writing abilities. These factors, which exert an impact on the learning process, consequently impede the mathematical achievements of students and contribute to the complexity of their responsiveness to instructional interventions. In this respect, different difficulties of students with MD can be supported (reading, attention, comprehension, and writing) and mathematics teaching can be shaped according to this dimension. In addition, in studies that developed an intervention program for students with MD, researchers don't use a standard assessment instrument to determine the mathematical difficulty (Mazzocco et al., 2013; Nelson & Powell, 2018). This situation might make it difficult to determine students that need intense academic support in math class. Furthermore, the utilization of various diagnostic methods for identifying students with MD complicates the comparison of findings across different studies on the topic, as highlighted by Nelson and Powell (2018).

Grade Level

According to the result of this second-order meta-analysis study, MD intervention programs have a lower impact on secondary school-level students. There is a medium-level impact on K12 level and elementary level students. Different ES values are calculated in the research studies focusing on the effect of education level on the mathematics performance of students with MD (Myers et al., 2022; Chodura et al., 2015; Gersten et al., 2009). The difference in the inclusion criteria might be the reason behind this difference. For instance, Myers et al. (2022) determined that intervention programs have a big effect on the primary school level. On the other hand, they reported a medium-level effect on the middle school level. Similar results are obtained in different studies on the topic (Gersten et al., 2009).

Students with MD who are at the primary school level have fewer topics to learn, and they have relatively basic-level topics. This fact increases the efficiency of interventions (Stevens et al., 2018). Students learn more complex topics as they continue their education. Researchers foresee that as the complexity of mathematics content increases in line with the grade, interventions create a more efficient development and support primary school students (Jitendra et al., 2018). When students with MD aren't supported in the mathematics learning process, they may fall behind their peers who develop normally (Nelson & Powell, 2018). This situation might make it difficult for these students to give reaction to the intervention. As mathematics is naturally volute, previous learnings are the basis of the following knowledge. Students with MD acquire their basic skills in primary school (Powell et al., 2017). When students aren't supported at an early age, interventions at the middle school level might have a low effect on their learning outcomes.

Publication Year

According to the results of this study, relatively recent meta-analysis research about MD produced a lower effect size. Further research can be carried out to see whether the results are similar or different in this regard. Seeing that the recent meta-analysis studies produced low effect size can be interpreted as a surprising result. This situation may be attributed to the inclusion of studies with larger sample sizes in recent meta-analysis studies. It is known that studies with small samplings produce higher effect size values (Gersten et al., 2009; Jitendra et al., 2018). On the other hand, it can be said that the pretest last-test randomized controlled trial studies are included in the research studies in which recent studies are analyzed. The inclusion of single-subject research studies before 2015 might have caused a high effect size. In recent meta-analyses, this tendency gave its place to experimental and quasi-experimental experimental studies. However, all these are simply some interpretations.

Location

It is determined that the impacts of meta-analysis research on MD vary according to the location they comprise. In this study, it is determined that the effect of MD intervention programs only in the USA is low. On the other hand, it is observed that global researches that comprise different countries have a higher impact. This situation might result from location bias. One of the bias problems in meta-analysis research can be location bias (Higgins & Green 2011). In their clinical practices, Vickers et al. (1998) showed that effect sizes vary according to the location of the country. A similar process can be part of the problem in practicing intervention programs.

Meta-Analysis Quality

In this study, the effect of MD intervention programs on students' mathematics performance didn't have a meaningful variation in terms of study quality. However, it can be said that the studies with higher study quality produce a higher effect size. It is expected that the studies on the impact of quality indicators on ED, studies whose study quality isn't calculated will report a lower ES (Stevens et al., 2018).

Quality indicators in special training studies are important for ensuring the support of literature to intervention programs (Cook et al., 2015). Findings should be evaluated in line with the quality of included studies (Stevens et al., 2018). Presenting the study quality might contribute to determining efficient intervention programs. The impact level of intervention programs on students with MD might differ. In this respect, quality assessments of intervention programs might allow interpretation of these programs. Calculating the quality indicators of interventions might contribute to the possibility to select efficient interventions for teaching mathematics to students with MD.

Suggestions

Three basic limitations are taken into consideration while interpreting the findings. Firstly, only 13 meta-analysis studies between the years 2009 and 2022 that analyze the impact of the mathematics intervention on the math performance of students with MD were determined. Researchers who plan to conduct future research on the subject may conduct more comprehensive second-order meta-analyses focusing on the effect of mathematics intervention on the mathematics performance of students with MD. Secondly, only the articles that use group experimental designs

in their design are included in the analysis. In a variety of simple subject design research, it is determined that there are positive impacts of mathematics intervention programs on the math performance of students with MD.

Single-subject research might give information about efficient intervention programs to support the mathematical performance of students with MD. In this regard, in addition to group experimental design studies, the outcomes derived from single-subject meta-analytical investigations can be amalgamated within the framework of second-order meta-analyses. Thirdly, intervention programs that are efficient in terms of increasing the mathematics performance of students with MD are determined. It is observed that intervention programs such as EI, SBI, TBI, CBI, and VR are efficient in teaching mathematics programs. However, when the fact that students with MD have different characteristics (heterogeneous) is taken into consideration, it can be said that different types of intervention programs can also be efficient in the process of teaching mathematics.

Ethic

All procedures in this study were conducted in accordance with the ethical standards of the 1975 Declaration of Helsinki.

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Development of Child to Parent Violence Scale (CPV-S): Investigating Psychometric Properties in Turkish Adolescents

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Abstract

The aim of this study is to develop a reliable and valid data collection tool for assessing child to parent violence in adolescents. A total of 418 students attending secondary education participated in the study, with 55% (220) being female and 45% (188) being male. Confirmatory and exploratory factor analyses were used to analyse the factor structure of the scale. The reliability of the scale presented in this study was evaluated using Item-total Correlations, Cronbach's Alpha (α) and McDonald's Omega (ω) coefficients. According to the results of factor analysis conducted in this study, it was determined that the Child to Parent Violence Scale (CPV-S) consists of 14 parallel items (Mother and Father forms) consisting of emotional, financial and physical violence dimensions. The results of Confirmatory Factor Analysis indicated that the scale generated good values for both the mother and father forms. Concerning criterion related validity, a significant positive relationship was found between child to parent violence for both mother and father forms and tendencies toward violence and adolescent-parent conflict. Lastly Cronbach's Alpha and McDonald's Omega coefficients for the Mother Form and Father Form is found to be sufficient. These results show that the scale presented in this study can be utilized to assess child to parent violence in adolescents.

Key Words

Adolescents • Child to parent violence • Reliability • Validity

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During adolescence, teenagers go through a phase of separating from their parents and establishing their individual identities. This process, which results in the acquisition of individualization, may sometimes involve a challenge or resistance to authority (Cottrell, 2001). In this respect, it is accepted that child-parent relationships are generally difficult during adolescence. In Western studies, conflict between adolescents and parents is considered an expected situation (Holmbeck & Hill, 1988). For this reason, many of the inappropriate behaviors that adolescents show towards their parents have been described as characteristics specific to adolescence. However, recent studies conducted in the last decade emphasize that some behaviors exhibited by adolescents may differ from normative behaviors specific to adolescence. Thus, studies that distinguishing between normative but inappropriate adolescent behavior towards parents and abusive child to parent behavior have increased (Simmons, McEwan, & Purcell, 2019).

Child to parent violence (CPV) was initially defined as a type of domestic violence by Harbin and Madden (1979). According to this initial definition, CPV was considered as "children's physical attacks, physical harm or verbal and non-verbal threats directed towards their parents." However, it became evident that this initial definition was functionally limited. Cottrell (2001) later defined the CPV term as "any behavior exhibited by a child aiming to cause psychological, physical, or financial harm to a parent with the intent of obtaining power and taking control over the parent." In more recent studies (Pereira et al., 2017), CPV is emphasized as a conscious, deliberate, and repeated action by the child towards the parent. Based on these definitions, CPV can be described "any intentional and repeated behavior that a child inflicts psychological, physical or financial harm on a parent for the purpose of gaining power and taking control over the parent". The term CPV is one of the most commonly used terms in the literature. However, different researchers have named the concept in various ways, such as parent aggression, adolescent-to-parent violence, child-to-parent abuse, parent abuse, adolescent-to-parent abuse (Simmons, McEwan, Purcell, & Ogloff, 2018).

Cottrell (2001) classified CPV into three categories: psychological/emotional (including verbal), financial and physical violence. Under the classification of physical violence, behaviors such as punching, kicking, pushing, spitting at the parent, throwing things or breaking items in the home, damaging walls or doors are included. In the dimension of psychological violence, behaviors such as playing malicious mind games, intimidating the parent, making unrealistic demands, intentionally not disclosing one's actions, running away from home, lying, threatening to harm the parent (physically harm, kill, etc.) or oneself (commit suicide, etc.), belittling, and withholding affection can be found. Verbal violence, includes behaviors such as shouting, arguing, swearing, making sarcastic and critical remarks, name-calling, expressing hatred. The third dimension, financial violence, consists of characteristics such as taking (stealing) money or the parent's belongings without permission, selling the parent's property, damaging the home or the parent's belongings, making demands for purchases that they believe they cannot afford, and incurring debts on the dor or wall that the parents are supposed to cover (Cottrell, 2001).

Prevalence of CPV in Adolescents

There is a great variation in studies on the prevalence of violence against parents. The first reason for the difference in the prevalence of violence is related to which behaviors are defined as violence (Cano-Lozano, León, & Contreras, 2021). Some behaviors included in the questionnaires assessing violence (such as yelling at parents in

anger or doing things that make them angry) are relatively more common during adolescence. When stricter criteria are included in the questionnaires, the prevalence of CPV decreased. For example, in a study where stricter criteria regarding violence against parents were established compared to another study with more flexible criteria, the rates of physical violence against parents decreased from 10.7% to 3.2% while the rates of psychological violence decreased from 92.7% to 14.2% (Calvete, Orue, & Gamez-Guadix, 2013).

The second reason for the variation in the prevalence of violence is the criteria used to determine the presence of violence. For instance, some studies claim that if adolescents have attacked their parents at least once, these adolescents are considered aggressive toward their parents. However, this behavior may be exceptional behavior (Ulman & Straus, 2003). In more recent studies, the repetition of violence has been determined as the main criterion of violence against parents (Pereira et al., 2017). As a result of differences in the definition of violence against parents, while the rates of violence are higher in studies based on the criterion of showing violence at least once, the rates are lower in studies that take the repetitiveness of violence as a criterion. For instance, in a study conducted in Spain by Calvete, Famez-Guadix and Orue (2014), between 86% to 92% of young people applied psychological violence against their parents, on the other hand the rates of repeated psychological violence ranged from 11% to %11.8 (Cano-Lozano, Leon, & Contreras, 2021a).

Prevalence of violence against parents also vary depending on the types of population studied (Contreras and Cano-Lozano, 2014). For example, the rates of violence in populations that include criminal samples (clinical and offender samples) tend to be higher than in the general population (Del Hoyo-Bilbao Gámez-Guadix, Orue, & Calvete, 2018; Ibabe, Arnoso, & Elgorriaga, 2014; O'Hara, Duchschere, Beck, & Lawrence, 2017). A study (Ibabe, et al., 2014) found that 67% of victims (adolescents who were reported by their parents to have committed violence against them) applied emotional violence, 84% applied psychological violence, 73% applied physical violence, and 53% applied financial violence to parents. However, rates in non-delinquent groups (adolescents in the community sample) were found to be relatively lower. These rates for emotional, psychological, physical and financial violence were reported as 65%, 42%, 29% and 21%, respectively.

In the scientific environment, the gender of young people who perpetrate violence against their parents has received significant attention. Some studies with general population samples report no difference between girls and boys (Ibabe & Bentler, 2016; Pagani et al., 2009). According to studies by Armstrong et al., (2018) and Simmons et al., (2018) in offender samples, boys exhibit more violence than girls. CPV also varies according to gender in physical, psychological and economic dimensions. In the studies, physical violence against parents was found to be higher in boys than girls (Cano-Lozano, et al., 2021a; Cano-Lozano, et al., 2021b), while psychological violence was found to be higher in girls than boys (Cano-Lozano, et al., 2021a; Cano-Lozano, et al., 2021b; Ulman & Straus, 2003).

The literature also points out differences regarding the gender of the victim. Especially mothers are the real victims of violence from their children. Verbal violence (Margolin & Baucom, 2014) and psychological violence (Calvete, et al., 2017; Cano-Lozano, et al., 2021a) are more frequently directed toward mothers. On the other hand physical violence is more commonly perpetrated by boys against their fathers than by girls (Cano-Lozano, et al.,

2021a). According to the statistics from the United Kingdom's police records, 77% of the victims of violence perpetrated by children were women (Condry & Miles, 2014; Pagani et al., 2004). In a study conducted in the United States, the rates of children of both genders and all ages engaging in violence against their mothers were higher than those against their fathers (Ulman & Straus, 2003). In a study conducted in Canada, the mean score of verbal violence against the mother (6.4%) was significantly higher than that against the father (5.6%) (Lyons, Bell, Fréchette, & Romano, 2015). In a study conducted in Spain, adolescents generally engaged in violence against their mothers more frequently than their fathers (Ibabe & Bentler, 2016).

Assessment of CPV

There is still limited knowledge about when a child's behavior must be considered as violence. This lack of knowledge makes it difficult to define and therefore assess CPV (Simmons, McEwan, & Purcell, 2019). However, it is crucial to assess CPV in order to make a decision about the importance of the problem. By this way, proper interventions can be developed to prevent CPV.

Calvete et al. (2013) developed a measurement tool called "Child-to-Parent Aggression Questionnaire" to assess CPV in Spanish adolescents. This scale consists of both physical and psychological aggression dimensions. The scale is applied to both mothers and fathers. The questionnaire is divided into two sections, one addressing the occurrence of violent behavior and the other focusing on the underlying reasons for these behaviors. Margolin and Baucom (2014) developed a specific instrument to assess financial aggression, physical aggression and verbal aggression in a sample of adolescents in the United States. Contreras, Bustos-Navarrete, and Cano Lozano (2019) developed a scale with Spanish adolescents called "CPV Questionnare". The scale consists of 14 items for mother and father form. The scale consists of four factors for mothers and fathers, including physical, psychological, financial violence and control/influence over parents. Contreras, Leon, and Cano-Lozano (2020) developed a scale with Spanish parents of adolescents called "Child to Parent Violence Questionnaire, Parent Version". It comprises 14 items and four subscale (psychological violence, physical violence, financial violence, and control/domain). Recently, Harries et al. (2022) developed the CPV Functioning Scale. The instrument is answered by the caregivers. It measures motivations for violence in three dimensions: reactive, emotional and proactive.

The Current Study

It has been observed that studies on CPV has been carried out in many countries, including Spain, Austria, Australia, Ireland, Germany, England, United States and Canada. As seen in the literature, many countries have started to create risk maps for CPV and develop preventive interventions (Ibabe et al. 2023; Wilcox et al., 2015). However, there is no statistical information regarding the current prevalence of CPV in Turkey (Özdemir-Bişkin, 2023). This is because there is no valid and reliable measurement tool to assess CPV in Turkey yet. Therefore, there is no scientific evidence as to whether CPV exists as a form of domestic violence. With this measurement tool, violence against mothers and fathers will be quantitatively revealed. Thus, the prevalence of CPV in the Turkish sample will become visible. For this purpose, this study aims to develop a valid and reliable measurement tool to assess CPV in adolescents.

Method

Working Group

Within the scope of the study, data collection tools were applied to three randomly selected schools in a province located in the Western Mediterranean region of Turkey. The data was collected during the fall semester of the 2022-2023 academic year. 426 students participated in the study. After erroneous or missing data cleaning, the number of participants decreased to 418. In the sample group, 55% (220) of the participants were female and 45% (188) were male. 17.9% (75) of the students were in ninth grade, 13.4% (56) in tenth grade, 24.2% (143) in eleventh grade, and 24.2% (101) in twelfth grade. Ten percent (42) of the students did not indicate their grade level on the application forms. While 80% (337) of the participants indicated their financial level as medium, 7.7% (32) indicated it as low and 11.7% (49) as high.

Data Collection Tools

In this study, data are collected using several data collection tools. For this purpose, a Personal Information Form (PIF), Violence Tendency Scale (VTS), and Adolescent Parental Conflict Scale (APCS) were used to collect data. Explanation of these tools are given as below.

Personal information form (PIF): It was prepared by the author and applied to the participants to determine the demographic variables of gender, class and financial level.

Violence Tendency Scale (VTS): This scale was developed by Haskan and Yıldırım (2012). The scale consists of a total of 20 items on a three-point scale. High scores indicate a high tendency toward violence. The Cronbach alpha coefficient of the scale was found to be .87. The results of the analysis show that the scale is a reliable and valid in determining the tendency toward violence in adolescents (Haskan & Yıldırım, 2012).

Adolescent Parental Conflict Scale (APCS): This scale was developed by Eryılmaz and Mammadov (2016). The scale consists of a total of 12 items on a four-point scale. High scores indicate high levels of adolescent-parental conflict. The Cronbach alpha coefficient of the scale was found to be .88. The results of the analysis show that the scale is a reliable and valid in determining the conflict between adolescents and parents (Eryılmaz & Mammadov, 2016).

Data Analysis

Conceptual and theoretical basis is important in scale development studies (Seçer, 2015). For this reason, after reviewing the literature, an item pool was created for the CPVS. In the creation of the item pool, the literature and measurement tools developed in different countries to assess violence against parents were utilized. It was observed that emotional, physical and financial dimensions of violence against parents were emphasized in the literature on violence against parents and in the measurement tools developed for different countries (Calvete et al. 2013; Cottrell, 2001; Contreras, et al., 2019; Margolin & Baucom, 2014). Therefore, a common pool of 42 items that meet these dimensions was created. A total of 22 items were written for emotional abuse, 10 items for physical abuse and 10 items for financial abuse. The 42-item scale battery was sent to four experts, two in the field of measurement and

evaluation and two in the field of psychological counseling. According to the expert options, it was decided that the items written for the emotional abuse dimension, which included parental threat and parental ridicule, could be combined among themselves. In this context, the items were organized and the number of items was reduced to 32. After the scale was given its first shape, a pilot study was conducted on 40 adolescents to test the comprehensibility of the items. At this stage, no items were discarded and the main analysis was started. The scale was applied to a group of students studying in different high schools in a province in the Western Mediterranean region of Turkey. Analyses of data are accomplished utilizing the SPSS 26 package program.

In the analysis, missing or erroneous parameters were first examined and the analysis was continued by assigning the series mean to the parameters with a missing rate below 5% (Seçer, 2015). The item-total correlations of the items were examined, and the reliability and validity of the scale are analyzed by exploratory and confirmatory factor analysis. Confirmatory factor analysis results were evaluated within the framework of Chi-Square ($\chi2$), $\chi2$/sd ratio), Comparative Fit Index (CFI), Standardized Residual Root Mean Square Error (SRMR), Normed Fit Index (NFI), Redundancy Fit Indicator (IFI), Root Mean Square Error Of Approximation (RMSEA) Fit Index and Goodness of Fit Index (GFI). For the $\chi2$/sd ratio, a value less than 3 corresponds to a good fit, less than 5 corresponds to an acceptable fit, and for SRMR and RMSEA, values less than or equal to .05 correspond to a good fit, and values less than or equal to .08 correspond to an acceptable fit. GFI, NFI and CFI results of .95 and above are considered as perfect fit, and values between .90 and .94 are considered as good fit (Kline, 2011; Sümer, 2000). The validity and reliability of the measurement tool was tested with SPSS 26 and AMOS 26 programs with a significance level of .05.

Results

To assess the validity of the scale, two kinds of factor analysis were applied on the forms. Firstly, exploratory factor analysis was applied for both the Mother and Father Forms. Then, according to the results obtained from exploratory factor analysis, confirmatory factor analysis was applied on the forms in order to evaluate the validity of the scale.

Exploratory Factor Analysis (EFA): This analysis was conducted to determine the factor structure of the scale and to select items. As seen in Table 1, Kaiser-Meyer-Olkin (KMO) and Barlett's tests were applied for multivariate normality and sample size (Field, 2009). For the mother form, the KMO value (.88) and Barlett's value were significant ($\chi2$= 8999.839 sd= 861, p=.00). Similarly, KMO value (.86) and Barlett's value were found to be significant for the father form ($\chi2$= 7820.517 sd= 861, p=.00). It was seen that the necessary criteria were met and factor analysis was started. Principal components method was preferred as the analysis type, varimax was preferred as the rotation technique, and factors with eigenvalues above one were included in the analysis (Büyüköztürk, 2010; Field, 2009). A factor loadings of .30 and .10 for overlap were taken as a basis (Çokluk, Şekercioğlu, & Büyüköztürk, 2012; Seçer, 2015).

Exploratory factor analysis revealed that, for both the Mother and the Father Forms, the scale was structured into 10. The eigenvalues of the factors were greater than 1. The ratio of the explained variance calculated by these 10 factors is 64.14% and 61.46% for the mother and father forms, respectively. Items that did not load on any factor, items with factor loadings below .30 and items with overlap above .10 were excluded from the analysis. Horn's

Parallel Analysis was conducted to determine the number of factors, and it was concluded that there are 3 factors for both the mother and father forms. The EFA was repeated for both forms by limiting the number of factors to three. After the repeated analyses, a three-factor structure consisting of 14 items with factor loadings above .30 was reached for both the mother form and the father form. According to the literature, these three factors were named as emotional violence (6 items), physical violence (4 items) and financial violence (4 items). The EFA results and reliability analysis results of both the mother and father forms of the scale are outlined in Table 1.

Table 1.

Factor Loadings and Item Total Correlations for the Child To Parent Violence Scale

	Mother Scale					Father Scale			
Item No	Factor1	Factor2	Factor3	r	Item No	Factor1	Factor2	Factor3	r
1	**.652**	.034	-.002	.553	1	**.718**	-.025	.053	.582
5	**.776**	.116	.120	.702	5	**.786**	.046	.101	.655
12	**.783**	.134	.156	.713	12	**.771**	.184	.019	.630
13	**.763**	.113	.142	.704	13	**.744**	.059	.162	.660
14	**.674**	-.094	.332	.657	14	**.617**	.169	.367	.706
17	**.753**	.141	.235	.735	17	**.634**	.207	.309	.709
23	.144	**.758**	.191	.470	23	.082	**.843**	.052	.375
24	.073	**.902**	.132	.447	24	.216	**.828**	.080	.488
25	.030	**.886**	.128	.409	25	-.001	**.679**	.208	.355
29	.107	**.645**	.284	.466	29	.114	**.578**	.276	.440
19	.113	.146	**.741**	.534	19	.098	.030	**.772**	.508
30	.107	.217	**.786**	.566	30	.139	.160	**.695**	.512
31	.199	.162	**.694**	.575	31	.112	.188	**.561**	.552
32	.235	.182	**.611**	.585	32	.162	.146	**.603**	.508
Explained Variance	35.45	16.69	9.20	61.35	Explained Variance	32.18	13.70	9.38	55.25
Cronbach's Alpha (α)	.84	.82	.73	.84	Cronbach's Alpha (α)	.82	.71	.57	.80
McDonald's Omega (ω)	.84	.82	.72	.85	McDonald's Omega (ω)	.83	.72	.57	.82
Eigenvalue	4.96	2.33	1.28		Eigenvalue	4.50	1.91	1.31	

Note: r refers to item total correlation value, Factor 1 refers to emotional violence, Factor 2 refers to physical violence, and Factor 3 refers to financial violence sub-dimensions.

For the Mother Scale, the factor loadings of items within the emotional violence factor ranged from .65 to .78, explaining 35% of the total variance. The factor loadings of items within the physical violence factor ranged from .64 to .90, accounting for 16% of the total variance. The final factor, financial violence, accounted for 9% of the total

variance, with factor loadings ranging from .61 to .78. When considering all three factors together, they collectively explained 61.35% of the total variance for the Mother form.

For the Father Scale, the factor loadings of items within the emotional violence factor ranged from .61 to .78, explaining 32% of total the variance. The factor loadings of items within the physical violence factor ranged from .57 to .84, accounting for 13% of the total variance. The financial violence factor accounted for 9% of the total variance, with factor loadings ranging from .56 to .77. When considering all three factors together, they collectively explained 55.25% of the total variance for the Father form.

Confirmatory Factor Analysis (CFA): The appropriateness of the factor structures obtained from the exploratory factor analysis was evaluated with two separate CFAs for the Mother and Father forms of the scale. In this study, both exploratory and confirmatory factor analyses were conducted on the same data set. At this point, there are discussions about using the same sample in CFA as EFA. Some studies recommend that if the sample is large enough, it should be divided into two, with EFA conducted on one half and CFA on the other (Fabrigar et al., 1999). However, it is also emphasized that this method may lead to biased results, especially in small sample groups, as the number of data decreases even further (Doğan, Soysal, & Karaman, 2017). Since the number of students reached within the scope of this research was limited, it was decided that it was not appropriate to divide the data into two. Worthington and Whittaker (2006) also claimed that performing EFA and CFA on the same sample would not cause any problems, on the contrary, the structure of the data would be revealed experimentally. Considering that there are debates on this issue, conducting exploratory and confirmatory factor analyzes on the same data set can be considered a limitation of the study.

Figure 1.

Confirmatory Factor Analysis Results for the Mother Scale

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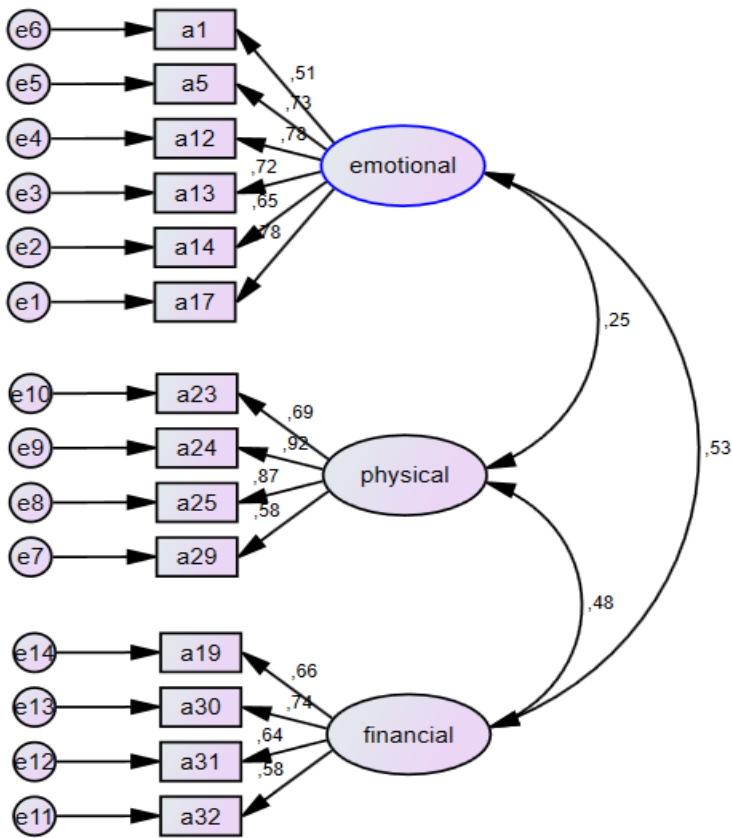
Figure 1, demonstrates the standardized parameter values of the confirmatory factor analysis for the Mother Scale. According to the analysis results, the model for the Mother Form of the Parenting Violence Scale produced good fit values ($\chi2$= 216.73, sd=74, $\chi2$/sd = 2.92, GFI=.93, NFI=.91, CFI=.94, IFI=.94, SRMR=.024, RMSEA=.068). Since the model produced good fit values, no modifications were made.

Figure 2.

Confirmatory Factor Analysis Results for the Father Scale
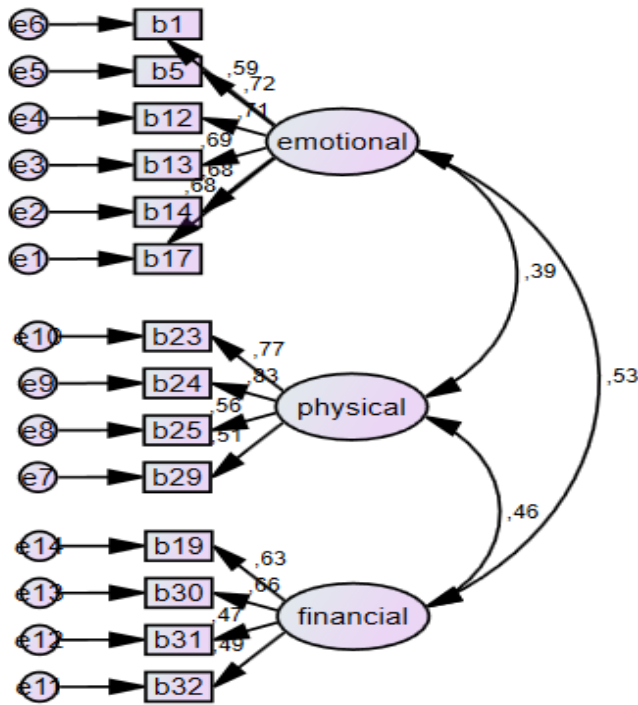
Figure 2, shows the standardized parameter values of the confirmatory factor analysis for the Father Scale. According to analysis results, the model for the Father Form of the Parenting Violence Scale produced good fit values ($\chi2$= 219.21, sd=74, $\chi2$/sd = 2.96, GFI=.93, NFI=.87, CFI=.91, IFI=.91, SRMR=.028, RMSEA=.069). Since the model produced good fit values, no modifications were made.

Criterion validity: For the criterion validity of the scale, the relationships between CPV and violence tendency and adolescent parental conflict are analyzed. Correlation values for the variables are given in Table 2.

Table 2.

Correlation Values Between CPV, Adolescent-Parent Conflict and Violence Tendency

Variables	Adolescent Parent Conflict	Violent Tendency
Violence to Mother (Mother Form)	.33**	.44**
Violence to Father (Father Form)	.35**	.31**

**p<.001

When the results of the analysis were examined, it was observed that both the Mother and the Father Scale demonstrated a meaningful positive relationship with adolescent-parent conflict and violence tendency.

Reliability Analysis: For reliability, İtem-Total Correlation, Cronbach's Alpha (α), and McDonald's Omega (ω) coefficients were calculated. It was observed that the item total correlation values for CPV ranged between .35 and .70. Cronbach's Alpha coefficient of the Mother and Father Scale is calculated as .84 and .80, respectively. Cronbach's Alpha coefficients for the sub-dimensions ranged between .73 and .84 for the Mother Scale and between .57 and .82 for the Father Scale. McDonald's Omega (ω) coefficients of the Mother and Father Scale is calculated as .85 and .82, respectively. McDonald's Omega (ω) coefficients for the sub-dimensions ranged between .72 and .84 for the Mother Scale and between .57 and .83 for the Father Scale. According to the results, the scale developed in this study can be utilized to assess CPV.

Conclusion, Discussion and Recommendations

In this study, it was aimed to develop a valid and reliable data collection tool to determine CPV in adolescents. For this purpose, high school students were asked how often they showed violent behavior towards their parents in the last six months. The data collected from high school students are analyzed. The results of the analysis indicate that the 14 items of the scale are grouped into three factors (emotional, physical and financial violence). Emotional violence is a way to control another person using emotions. In this context, there are scale items such as raising the voice when angry with the parents, asking them to shut up, criticizing them, and not fulfilling their requests are included. Within the scope of physical violence, there are scale items about hitting, kicking, slapping and scaring the parents with something that could injure them. Within the scope of financial violence, there are items such as making demands that the parent cannot fulfill, taking money without permission, and using belongings without permission. The factor structure obtained as a result of analyses shows a similar structure in Turkish culture to that in other cultures. For example, Calvete et al. (2013) named the factors physical and psychological violence in the measurement tool they developed for CPV. Similarly, the sub-dimensions of the measurement tool developed by Contreras, et al., (2019) to measure CPV consist of psychological, physical, financial violence and control dimensions. The measurement tool developed by Margolin and Baucom, (2014) to assess CPV consists of psychological, physical and financial violence sub-dimensions. Within the scope of criterion validity, the relationship between CPV and adolescent parental conflict and violent tendency was examined and a significant positive relationship was found between the scales.

Internal Consistency Values (α and ω values) were examined within the scope of the reliability. Internal Consistency Values of .70 and above are accepted in social sciences (Seçer, 2015). In this study, Cronbach's Alpha and McDonald's Omega values of Mother Scale (α=.84, ω=85) and Father Scale (α=.80, ω=82) are greater than .70. However, since the Internal Consistency Coefficients (α= .57, ω=.57) of the financial violence sub-dimension in the father form is below .70, it would be appropriate to pay attention to this limitation in the use of the scale. A high score on a four-point scale (Never=1, Once=2, A Few Times=3, Most of the Time=4) indicates a high level of CPV. The scale can be evaluated on separate total scores for the Mother and Father forms, or the sub-dimensions of each form can be used separately.

The results obtained in this study should be evaluated within some limitations. In this study the measurements are based on self-reports of adolescents. Therefore, it will be required to include parent reports in future studies. Another

limitation is that the reliability and validity analysis of CPV-S in this research was carried out on the normal population. Therefore, it will be useful to conduct further studies investigating the psychometric properties with clinical groups. As a result, it is as valid and reliable tool to evaluate CPV in academic studies, in also professional settings. Since the scale consists of few items, it will be useful in evaluating violence against parents in large groups in a short time. It is expected that the measurement tool will contribute to evaluate the CPV levels of Turkish adolescent groups. Thus, the results will also contribute to social and school-based prevention and intervention studies on violence.

Ethic

This study was conducted in accordance with the ethical standards outlined in the 1964 Helsinki Declaration and its later amendments.

Funding

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Social Strategies in Language Learning for Promoting Speaking Skills

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Abstract

The purpose of this study is to investigate the use of social strategies in language learning to promote speaking skills. The study was designed in the survey model. The participants of the study were divided into three groups in a sample lesson. They were asked the question of "Why should we learn foreign language?" and were required to prepare and present a poster as a group. During the implementation phase, students were observed by the researcher through the "Speaking Skills Group Observation Form". The results of the research showed that all three groups exhibited sufficient speaking effort, participation in activities, involving in poster presentations, and peer interaction. The results of the research revealed that social strategies tend to improve speaking skills and increase willingness to speak. It was also revealed that students were aware of the significance of foreign language education as a crucial skill in today's modern world. They associated foreign language learning with the following words: culture, democracy, education, empathy, friendship, intercultural learning, job opportunity, love, peace, open-mindedness, relationship, religion, respect, tolerance and trust. Furthermore, it was concluded that social strategies in language learning can be effectively employed in foreign language classes to reduce speaking anxiety.

Key Words

Foreign language learning • Speaking skills • Social strategies • Speaking anxiety

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Introduction

In the ever-changing and evolving world, continuous efforts are made to make educational activities more effective and efficient. The aim of these efforts is to enhance effectiveness and improve success in education and teaching. In the contemporary world, education, mainly foreign language learning, plays a crucial role in responding to the requisites of globalization (Akpınar Dellal & Balkaya, 2022). Hence, the development of efficient methods, techniques, and strategies is a pivotal factors to enhance learning efficiency.

During the 1960s, a considerable transformation occurred in psychology and education. This era witnessed a notable transition from behaviorism to cognitivism (Hişmanoğlu, 2000; Wiliams & Burden, 1997) and this led to the explanation of the effect of cognitive processes that in second language acquisition and foreign language learning on learning process and behaviors (Zare, 2012). The concept of strategies began to be associated with the efforts of proficient language learners to derive meaning from context (Solak & Çakır, 2015). Then learning strategies, particularly language learning strategies become a significant subject of educational research. Language learning strategies were first introduced to the literature in 1975 with Rubin's article and have remained a subject of research, frequently investigated and adapted to various learning contexts. Rubin (1975) provided a definition for strategies, referring to them as the methods or instruments that a learner can employ in order to gain knowledge. On the other hand Oxford specified (1990) language learning strategies as specific actions that students undertake to make the learning process more enjoyable, self-directed, and transferable across different situations, thereby facilitating and expediting it. Besides O'Malley and Chamot (1990) described language learning strategies as actions to cope with effective information processing. Otherwise Wenden (1998) characterized language learning strategies as the mental steps or processes, that learners use to organize their efforts to acquire a new language. Language learning strategies alleged to be more than 100 in number (Lee, 2010), were subjected to attempts at definition by many scholars and researchers, however, it is not possible to mention a specific definition of the term language learning strategies. They serve as a good indicator of how students approach tasks or challenges encountered during the language learning process (Hişmanoğlu, 2000).

Although the literature presents an ambiguity in language learning strategies' definitions, it can be seen that the efforts to define revolved around three indicators that refer to cognitive learning theory: (1) conscious actions, behaviors, and techniques used by good language learners to improve their own learning processes, involving internalization, storage, retrieval and usage of foreign language acquisition or second language acquisition (Rubin, 1975; Oxford, 1990) (2) active self-directed engagement tools used to improve foreign language or second language acquisition communication skills (O'Malley & Chamot, 1990; Wenden, 1991), (3) and metacognitive, cognitive and social affective learning processes, which is the combined upper categorization of these two (Chamot & O'Malley, 1987). In particular, Dörnyei (2005) argued for abandoning the term 'strategy' and adopting the concept of self-regulation. He contended that the theoretical foundation of language learning strategies should be questioned because it is impossible for strategies to be cognitive, emotional, and behavioral simultaneously. He further contended that language learning strategies emerge without the practical guidance that students need from their instructors. On the other hand Gu (2012) argued that replacing the concept of language learning strategies with the structure of self-

regulation, as the latter extends beyond the development of linguistic knowledge in defining the conceptual boundaries of foreign language learning or second language acquisition processes and outcomes, might not be a sound indication. He further contended that language learning strategies emerge without the practical guidance students need from their instructors. Hence, language learning strategies are adaptable behaviors that vary across various learning contexts and environments. Language learning strategies constitute a toolkit for the foreign language learner to engage in active, conscious, purposeful, and attentive learning, with the aim to pave the way for greater competence, autonomy, and self-regulation (Hsiao & Oxford 2002). It has been argued that rather than focusing on specific behavioral habits, attention should be directed towards elements encompassing general learner characteristics (Dörnyei & Ryan, 2015). Language learning strategies encompass specific actions, behaviors, or techniques that play a facilitative role in acquiring the desired language proficiency (Oxford, 1990).

Despite various definitions and classifications of language learning strategies, the classification proposed by Oxford (1990) is the most preferred by foreign language educators. Oxford's strategies consist of two main categories: direct and indirect strategies, each further divided into three subcategories, resulting in a total of six categories. Memory strategies enable language learners to store verbal material and retrieve it when needed for communication, aiding them in coping with challenges. Cognitive strategies form the foundation of learning a new foreign language, allowing language learners to comprehend and produce the language in various ways. Compensation strategies enable language learners to use the foreign language despite gaps in their knowledge. However as indirect strategies metacognitive learning strategies are essential for successful language learning as they enable students to regulate and control their own cognitive processes. Affective strategies enable students to become aware of their own emotions and cope with these feelings and provide control over affective factors influencing learning. Social strategies facilitate the process of learning a new language through interaction and communication. These strategies such as increased communication among friends, language practice, and group activities can improve speaking skills (Oxford, 1990). In the realm of social strategies, students collaborate collectively. Consequently, they had opportunities to converse and learn from each other. These tactics prove effective for deliberating and refining task solutions, which can subsequently be showcased to the entire group. As evident, social strategies are steps that facilitate learning and enhance success in foreign language education. They assist learners in acquiring a new foreign language and in communicating in that language. Furthermore Oxford's classification is valuable for its applicability in teaching the four fundamental language skills: reading, listening, writing and speaking making it widely used in foreign language education. It is a well-known fact that employing effective methods and strategies in language instruction by helping to optimize learning processes and enables learners to enhance their language skills. These strategies also enable learners to understand course content more effectively and help them know how to plan and manage the learning process. Therefore, focusing on language learning strategies in language teaching is a crucial step to enhance success (Hişmanoğlu, 2000). In conclusion, it can be said, that taking advantage of learning strategies in foreign language lessons plays a significant role for effective and efficient foreign language lessons.

In contemporary foreign language teaching the aim is to develop and promote the four fundamental language skills equally. However, researches indicate that in the foreign language education speaking and listening skills tend

to develop more slowly than reading and writing skills. The speaking skill is a complex skill in which multiple dimensions of linguistic action interact. It is an essential building block for interpersonal interaction and for establishing and maintaining relationships (Barkowski & Krumm, 2010). In speaking skill, various components such as accurate pronunciation, suitable discourse behavior, and appropriate speaking pace must be balanced (Henrici & Riemer, 1996). This skill is an essential aspect of foreign language instruction and relies on previously acquired subskills, such as vocabulary and grammar knowledge (Çakır, 2017). In this skill learners are expected to be able to comprehend everyday situations and interact communicatively by acquiring communication abilities and express themselves adequately (Akol & Asutay, 2011; Storch, 2009). This can be achieved through continuous communication and conversation and it can be improved through the actual practice of speaking the target language (Huneke & Steinig, 1997). In conversation, there is a continuous exchange of roles where one communication partner switches between the roles of listener and speaker, often in a rapid succession, during direct oral information exchange with one or more other participants (Storch, 2009). This constant role-switching becomes a significant issue for learners who do not feel sufficiently proficient in target foreign language. Because attempting to comprehend what is being said and providing appropriate responses requires multifaceted thinking skills.

In addition, it is known that there are certain internal factors originating from the learners and external factors from the environment that negatively affect the speaking skills. Such as emotions are difficulties, which arise during speaking, impact not only on the foreign language learning process but also the learner's success (Rösler, 1994). One of these emotions is speaking anxiety. Incorrect pronunciation, making mistakes that lead to misunderstandings, and struggling to find the right words are some of the fears experienced by foreign language learners, which contribute to speaking anxiety (Apeltauer, 1997). Learners hesitate to speak because they fear making mistakes and using incorrect expressions (Yalçın, 2021). For this reason speaking is regarded as the most anxiety-inducing skill among the four language skills (Young, 1991). By utilizing suitable activities, methods, strategies, and resources, teachers can create a conductive environment and a pleasant atmosphere, awakening students' interests and bolstering their self-confidence. This motivates them to speak and enhance their speaking skills (Erdrova, 2015). Communication in the classroom can be encouraged through various sources and the opportunities based on students' issues or topics of interest enhance their willingness to speak (Storch, 2009). For this reason, communication topics should be created based on the learners' attitudes and needs (Huneke & Steinig, 1997). Exactly, choosing content and activities that engage students, arouse their interests and desires, and encourage them to speak will not only alleviate speaking anxiety but also improve their speaking skills.

Purpose of the Study

Upon reviewing the literature, there are studies that investigate learning strategies (Akıllılar & Uslu, 2011; Akol Göktaş & Köksal, 2022; Balkaya, 2022; Balkaya & Çelikkaya, 2022; Bekleyen, 2006; Çelikkaya, 2012; Karamanoğlu, 2005; Ünal, Ayırır, & Arıoğul, 2011). Similarly, various studies on foreign language speaking anxiety are encountered (Balkaya, Arabacıoğlu, & Çakır, 2020; Duman, Görel, & Bilgin, 2017; Enez, 2017; Horwitz, Horwitz, & Cope, 1986; Süleymanova, 2011; Şahin Toptaş & Koçak, 2021; Yılmaz & Sakarya Maden, 2016; Zengin & Şahin Toptaş, 2023). However, studies simultaneously addressing learning strategies and speaking anxiety are rare

(Oflaz, 2019). It was observed in conducted studies that foreign language learners experience speaking anxiety. Based on this view, the primary aim of this research is to investigate whether foreign language speaking anxiety can be reduced through social strategies. As a natural consequence, it aims to develop speaking skills, and it is believed that this study will make significant contributions to the field of German language teaching. In line with this primary aim, answers were sought for the following questions:

1. Can speaking anxiety be reduced through social strategies in language learning?

2. How will social strategies in language learning affect speaking skills?

3. What are the effects of social strategies in language learning on foreign language lessons?

Additionally, in order to encourage students to engage in conversations, findings from the posters they prepared to answer the question "Why should we learn a language?" are included in the results section, as these posters contain essential data from both the posters and the presentations.

Method

Research Design

This study was designed within a survey model. A survey model aims to describe the subject of research, event, individual, or object of interest, either in the past or in the present, within its own conditions and as it exists (Karasar, 2013). In this study, the survey model was chosen to reveal the existing condition as it is.

Research Group

The participants of this study consisted of 1st-year students of German Teaching at Muğla Sıtkı Koçman University Faculty of Education. A total of 24 students participated in the research. These students were randomly divided into three groups to form the study group for the research.

Research Instruments and Processes

In this study, data collection was provided by a group observation form during poster preparation and presentation. The research data were acquired through the observation method. Observation provides the researcher with an in-depth and valid opportunity to examine the desired subject (Karasar, 2013). "Speaking Skills Group Observation Form" prepared by the researcher for the purpose of determining the students' speaking skills, was used as the data collection tool in this study. In this developed group observation form, main themes were categorized into four themes: speaking effort, participation in activities, involving in poster presentation and peer interaction. A rubric form prepared through rating has three sub-dimensions: weak, can be improved, and sufficient. In the table 1, the dimensions and sub-dimensions of the group observation form are presented.

Table 1.

Speaking Skills Group Observation Form

Dimensions	Sub-dimensions
speaking effort	• willingness
	• put forth their ideas
participation in activities	• preparation of the poster
	• speaking comfort
	• present the poster
involving in the poster presentation	• answer questions
	• speaking comfort
peer interaction	• engage in discussions with peers
	• exchange of ideas with peers

As a second data collection method, posters prepared by group members were used as part of the social strategies employed.

Data Analysis

Descriptive statistics were used in the analysis of the data. While measuring speaking skills, the performances displayed by the students within the given task context were taken into consideration for evaluation. During the implementation of teaching model, the teacher shifted away from the instructional role and took on the role of a guide by observing students. The researcher's recorded observation notes and the "Speaking Skills Group Observation Form" were analyzed using descriptive statistics. To ensure validity and reliability, the forms of the co-observer were compared.

Teaching Model Implementation

Social strategies recommended by Oxford (1990) were examined within the context of the subject area. Firstly, a teaching plan was developed by the researcher for these strategies. The activities in this study are organized according to the stages of the foreign language course in the curriculum. Subsequently, a sample lesson model was constructed based on this teaching plan, incorporating expert opinions. Finally, the refined teaching model was implemented to students. The teaching model was implemented to students in the following manner:

To pique students' interests and activate their prior knowledge, in the previous week's class, students were assigned research the benefits of learning a foreign language for individuals. Since students have been involved in foreign language education for about 7-8 years, the topic "importance of foreign language learning" was chosen. Additionally, every student has an opinion on this subject, making it a topic for students to think about critically and engage with. The designed teaching model was applied as follows:

Introduction Phase: The teacher entered the classroom, greeted the class, and asked if there were any issues or problems. Due to the low number of students in the classroom, the teacher divided the class into three groups. While doing so, the teacher counted the students as 1-2-3, starting over after each count.

After completing the counting process, the teacher instructed students who were assigned the number 1 to gather on the left side, students with the number 2 to gather in the middle, and students with the number 3 to gather on the

right side. The purpose of this arrangement was to enable students who communicate less with each other to participate in activities together, and by allowing these students the opportunity to get to know each other, to minimize their social anxieties. Subsequently, the teacher gave each group a colored cardboard and pencils and then asked the research questions:

"Why should we learn foreign languages?"

"What benefits provide us learning a foreign language?"

The students were asked to reflect on this topic and express their thoughts on the colored cardboard. While preparing these cards, they were instructed to communicate only in German with each other. It was emphasized that everyone must express their opinion and persuade their group mates about their thoughts. Additionally, students were informed that they could use online or printed dictionaries if needed.

Presentation Phase: In this phase, it was observed that students approached each other with reluctance and shyness. To encourage students who were reluctant to participate in the activity and typically had limited communication with each other, the teacher went to the groups and asked, "Why do you learn German?" Some students responded with reasons like for work, while others mentioned wanting to go abroad. The teacher then remarked, "See, that's a good starting point. So, learning a language brings us what?" and the students mentioned job opportunities. The teacher used this as a starting point and guided other groups as well.

Semantization Phase: Seeing that the groups were engaging in communication, writing on the cardboard, and drawing shapes, the teacher continued to go around to each group, observing what they were doing. The teacher asked the students what they were doing. The students explaining their work helped their group mates in find the words they couldn't remember and correct grammar mistakes. And during this process, they found new concepts, shapes, and expressions to add to the cardboard while enhancing each other's ideas. As a result, the cardboard they prepared became enriched. While preparing their own cards, they also engaged in short dialogues with close friends from other groups about what they were doing. Additionally, there were friendly exchanges like "Our poster turned out better" during the activity. Sufficient time was given for the students to finish their posters. When all the posters were completed, the students were told to present them to other groups. Then break was taken.

Practice Phase: In this phase, the students introduced their prepared posters to their peers in other groups. Each student in the group shared information about the poster. Students from other groups asked questions to the students presenting, and in return, they received answers from the group members.

Results

The primary aim of the research is to seek an answer to the question: "Can speaking anxiety be reduced through social strategies in language learning?" When the group observation forms were examined, it was evident that all three groups showed in four dimension of form generally sufficient speaking effort, participation in activities, involving in poster presentations, and finally, levels of peer interaction. Furthermore, when individual assessments were conducted rather than group assessments, it was observed that only the sub-dimension of responding to questions needed improvement. This was due to the fact that only some students in the group responded to the

questions, while others remained silent. In addition to this, when the sub-dimensions of the group observation form were examined, it was observed that some students' speaking comfort in, involving in poster presentations, was lower compared to speaking comfort in participation in activities.

The research also forms the other sub-problem: How will social strategies in language learning affect speaking skills? The research results generally revealed that social strategies tended to enhance speaking skills. Additionally, it was observed that these strategies increase the willingness to speak; even leading students who wouldn't typically speak in class or less speak to engage in conversations among themselves. Furthermore, when comparing student' conversations in small groups while preparing posters to speaking in front of the whole class during poster presentations, it was observed that speaking anxiety was lower and the speaking comfort were higher in small groups' conversations. Additionally, students were more inclined to speak comfortably during poster preparation because they were engaged in a task and felt a sense of belonging to the group. In conclusion, based on these observations, it can be said that social strategies had a positive impact on speaking skills.

The final research question: What are the effects of social strategies in language learning? were grouped under several headings: First of all social strategies can improve speaking skills. Following the random grouping of the class, it was observed that students who didn't communicate much with each other initially were not eager or willing to work together and hesitated to collaborate. Later, with the encouragement of the teacher, when they began to work, it was observed that they started communicating with each other, listening to each other's ideas, and helping each other recall difficult words. It was also observed that they supported each other's ideas and made efforts to persuade others when they had different opinions or viewpoints. It was also observed during the presentation that a sense of belonging within the group developed, and they effectively introduced and defended the poster they had prepared. Additionally, it was noticed that students who were normally hesitant and reluctant to speak in class were observed to participate in discussions within their groups actively. Furthermore, it was observed that students divided tasks within the group for actions like drawing pictures and writing, with each individual leveraging their skills to contribute to the posters. This way, they actively engaged in the learning process. Due to the allowance of using dictionaries during the preparation and presentation of the posters, students had the opportunity to learn new words and enhance their vocabulary as well. Additionally, by correcting each other's mistakes, they identified their grammatical shortcomings and underwent peer assessment. In summary, in the research showed that every student actively participated in the process, students were able to engage in meaningful exchanges of ideas with each other, and they effectively presented their prepared posters.

Furthermore, since significant findings were obtained from the designed sample lesson, these findings were also presented. First, the posters created by students were introduced. Second, the intentions and messages conveyed by students through the writing, symbols, and images they used during their poster presentations to the class were analyzed. In other words, the expressions and discourses used by the groups while presenting these posters constituted the second finding of the study. It was revealed what messages the group members intended to convey through the images and symbols used in the posters. The poster prepared by the first group is shown in figure 1.

Figure 1.

The Poster of the First Group

As can be seen from the figure 1, the students focused on emphasizing that foreign language education will provide learners with intercultural learning. They depicted people from different nations carrying the flags of their respective countries on top of the world atlas image, and they wrote "hello" in various languages. Additionally, they reflected symbols of different religions and currencies and the figure carrying a puzzle piece by incorporating images on their posters. The poster prepared by the second group of students is shown in figure 2.

Figure 2.

The Poster of the Second Group
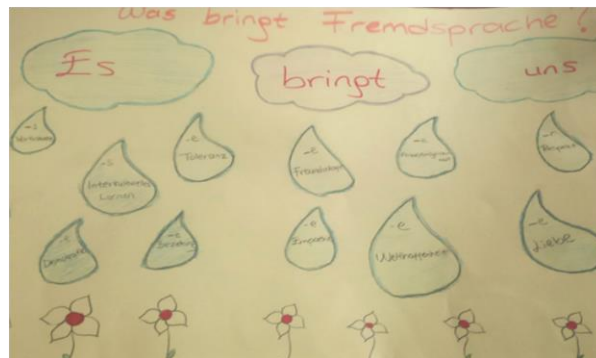
As seen in figure 2, the students from the second group wrote the question "What bring to us foreign language?" and underneath, they wrote "it brings us" and added descriptions within raindrop-shaped symbols they created. They wrote the following words in the raindrop-shaped symbols: Trust (-s Vertrauen), education (-e Bildung), democracy (-e Demokratie), intercultural learning (interkulturelles Lernen), tolerance (-e Toleranz), relationship (-e Beziehung), empathy (-e Empathie), friendship (-e Freundschaft), job opportunity (-e Arbeitsmöglichkeit), open-mindedness (-e Weltoffenheit), respect (-r Respekt), love (-e Liebe), peace (-r Frieden). They draw flowers beneath the raindrops. Lastly, the figure 3 depicting the poster of the third group was presented.

Figure 3.

The Poster of the Third Group
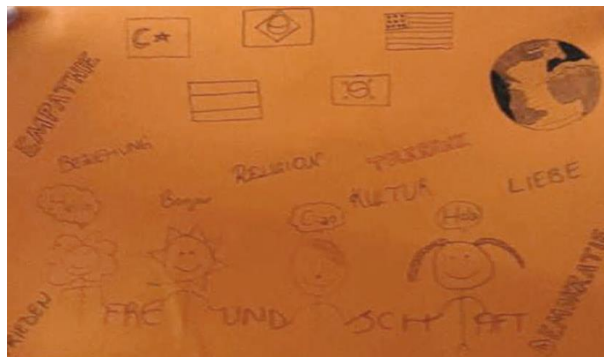
As can be observed in figure 3 as well, the students from the third group illustrated the flags of various nations at the top of the poster they prepared. They placed a world atlas on the right side of the poster and wrote the following words in the middle of the poster: peace (-r Frieden), relationship (-e Beziehung), empathy (-e Empathie), religion (-e Religion), culture, (-e Kultur), tolerance (-e Toleranz), love (-e Liebe), democracy (-e Demokratie). At the bottom of the poster, they wrote the syllabic form of the word "Friendship" carried by people saying "hello" in different languages.

Secondly, the messages that the students aimed to convey through the written content, symbols and visual elements on the posters during the presentation were emphasized. In Figure 1, students emphasized that, thanks to learning a foreign language, intercultural understanding takes place, showcasing the coexistence of different nations and languages in the world. Additionally, they indicated to highlight the presence of various currencies and draw attention to the existence of people from various religions worldwide. Lastly, they conveyed the idea that the figure carrying a puzzle piece symbolizes how differences come together to form a whole. They argued that the coming together of differences creates a cultural mosaic, and they contend that this represents a magnificent whole. During the presentation, a student from another group asked how they established a connection between language learning and currency. The students mentioned that currency is a cultural element and also pointed out that they included it in the poster because they believed learning language would provide job opportunities and enable them to earn money. Another student also mentioned that in the phrase intercultural learning (das interkulturelles Lernen) [The correct version is as follows: interkulturelles Lernen /das interkulturelle Lernen], students made an adjective phrase error. The students from the group mentioned that they didn't notice this mistake and thanked their friends for the correction.

In the second poster, the students expressed that they wrote "What bring to us foreign language?" on the poster, and in response, they articulated what they wrote as "It brings us" the following things: Trust, education, democracy, intercultural learning, tolerance, relationship, empathy, friendship, job opportunity, open-mindedness, respect, love and peace. They indicated that they associated people with the flowers they drew on the bottom part of the poster. They expressed that by writing words inside the shapes they drew for raindrops, they wanted to draw attention to the idea that just as rain nurtures and develops flowers, and these concepts also develop people. They stated that through

foreign language, all the mentioned concepts thrive, and individuals who are proficient in language are more enlightened, more tolerant towards different perspectives, and capable of empathy. When a student from the other group inquired about how job opportunities relate to personal development, the students responded that job opportunities allow individuals to communicate with different people, engage in teamwork, and facilitate the exchange of ideas. In this group, a student also pointed out that the students made a grammatical mistake. "It brings us (Es bringt uns)", [the correct version is as follows: Sie (Fremdsprache) bringt uns].The students from the group mentioned that they didn't notice this mistake and thanked their friends for the correction. It could be said that they made this pronoun error because they directly transferred the features of the English language, which they had previously learned, to the German language.

In the third poster, the students expressed that through the flags of different nations, they wanted to convey that individuals can have the opportunity to closely familiarize themselves with the characteristics of other countries through foreign languages and show respect for these attributes. They indicated with the image of the world atlas that foreign language provides the opportunity to get to know people from different parts of the world. Furthermore, they stated that with the image representing the syllabic form of the word "Friendship" carried by people saying "hello" in different languages, they wanted to emphasize that learning a foreign language can provide the opportunity for individuals to establish friendships with people from different nations. This way, people can get to know each other more closely and contribute to a more peaceful world. They mentioned that foreign language also increases the possibility of learning about and getting to know other cultures.

According to these findings, it can be observed that the primary objective of the research, which is to develop speaking skills by alleviating speaking anxiety through social strategies, was confirmed.

Discussion, Conclusion & Suggestions

In this research, the aim was to reduce speaking anxiety and consequently enhance speaking skills through the utilization of social strategies in foreign language learning. The research revealed that all three groups were generally sufficiency in all of the four dimensions of the "Speaking Skills Group Observation Form". However, when individual assessments were conducted, the sub-dimension related to responding to questions needed improvement since only some students in the group responded to the questions while others remained silent. Additionally, it was observed that the speaking comfort of some students during poster presentations was lower compared to their speaking comfort during participation in activities. Both of these findings confirmed the notion that social strategies can reduce speaking anxiety. It is known that social strategies enhance success by facilitating group interaction (Oxford, 1990). It was observed that students are less anxious and less reserved in group activities, they feel more comfortable with their group mates, and they have a greater willingness to speak. Özalp and Merç's study (2022) showed that speaking anxiety had a significant effect on willingness to communicate, and that willingness to communicate also has an effect on speaking anxiety. For this reason it is necessary to eliminate speaking anxiety in foreign language learning and teaching, or at least it should be reduced. There are also studies indicating that speaking anxiety negatively affects foreign language speaking skills (Balkaya et al., 2020; Duman et al., 2017; Şahin Toptaş & Koçak, 2021; Yılmaz & Sakarya Maden, 2016). To enhance speaking skills, it is essential to conduct

research and undertake studies aimed at preventing or at least reducing negative emotions such as anxiety. The research revealed that students who are normally afraid, reluctant or shy to speak German in class are speaking German with their friends and fulfilling their assigned tasks within the small groups. It is thought that students' self-efficacy beliefs develop by fulfilling these tasks. Self-efficacy, as one of the most crucial emotional resources, is a significant intrinsic motivating factor affecting learning (Tanır, 2023a). Therefore, it can be said that using social strategies in foreign language learning and teaching reduces speaking anxiety and develop self-efficacy.

Learning a language is a collaborative endeavor, and effective social strategies play a crucial role in facilitating this process (Oxford, 1990). Before the posters were prepared, it was observed that the students were reluctant to work together with their classmates, with whom students do not communicate much in normal circumstances. Therefore, it can be said that social strategies both increase the willingness to learn and provide communication. When examining the relationship between students' end-of-term grades and the language learning strategies they employed, a connection was discovered between their success levels in speaking lessons and the use of various strategies (Bekleyen, 2006). Furthermore, students' speaking skills in small groups during poster preparation were better compared to poster presentations. Hence, it can be concluded that speaking anxiety was lower, and the level of speaking comfort was higher in small group conversations. In the study of Arslan Buyruk et al. (2018), students stated that they had more opportunity to speak in teaching techniques in which they were more active. Additionally, students were more inclined to speak comfortably during poster preparation because they were engaged in a task and felt a sense of belonging to the group. In conclusion, based on these observations, it can be stated that social strategies had a positive impact on speaking skills.

Upon reviewing the existing literature, it can be observed that there are various studies in the frame of language learning strategies in Turkey's foreign language education context (Çelik Korkmaz, 2013; Ünal et al., 2011). Furthermore, when the literature was analyzed, it was found that the relationship between academic achievement and learning strategies had been frequently investigated. Demirel (2012) conducted a study to determine whether there were significant differences in language learning strategy use among university students based on gender and academic achievement. The study revealed that language strategy use was directly related to language achievement. In the studies conducted by Solak and Çakır (2015) and Balkaya (2022), a positive relationship between language learning strategies and academic achievement in language learning was demonstrated. Similarly, in the studies by Lee (2010) and Kean (2018), it was shown that successful language learners frequently use learning strategies, while less successful students are often unaware of these strategies. Language learning strategies not only enhance language skills but also assist in regulating learning processes, enabling students to manage them more independently.

Although not originally one of the main objectives of the research, another finding obtained from the study was that students could become aware of each other's mistakes. In the study of Memduhoğlu et al. (2014) it was seen that, with cooperative group techniques students realize their own mistakes and choose how to correct them. Some students made mistakes as they were influenced by the English they had previously learned. One could argue that they made this pronoun error because they directly transferred features from the English language to the German

language. This finding is consistent with study of Tanır (2023b). In this study, it was revealed that students learning German as a third language made morphological mistakes. While preparing and presenting posters, students had the opportunity to compare themselves with their peers and become aware of the areas they were lacking in through correcting each other's mistakes. This was achieved by students correcting each other's errors, even though it wasn't originally one of the main objectives of the research. Furthermore, students realized that they could communicate with their classmates beyond just a few close friends, and they had the opportunity to work together to create a valuable outcome and defend it. As a result, their sense of group belonging also developed. Similarly in the study of Batdı (2013) concluded that cooperative learning directs students to interaction and communication and provides social development. Thanks to social strategies, students learned new words by asking the teacher or their peers or by looking them up in the dictionary. In their study Çelikkaya (2012), Demirel (2012) and Biçer and Polatcan (2015) determined that, students used language learning strategies to learn new words to enhance their vocabulary sufficiently. Students were able to use these words during their presentations actively. In this frame advised Cesur and Fer (2011) based on their study results teachers to practice the students to use the newly learned word in sentences. Students also experienced engaging in different viewpoints and respecting these perspectives during the process. The most significant finding of the research was that all students had actively participated to prepare and present to the posters throughout this process.

The research showed that students are aware of the significance of foreign language education as a crucial skill in today's modern world. Furthermore, it is known that learning a language provides individuals with new perspectives and enhances their worldview (Akpınar Dellal, 2013). In support of this view in the research, it was observed that students associated foreign language learning with the following words: culture, democracy, education, empathy, friendship, intercultural learning, job opportunity, love, peace, open-mindedness, relationship, religion, respect, tolerance and trust. Arabacıoğlu and Balkaya (2023) asserted that the incorporation of cultural elements into the study of a foreign language can enhance learner's expressive skills, communicative proficiency, and intercultural competence. Learning a new language exposes individuals to different cultural contexts, allowing them to engage with diverse ideas and viewpoints. As they interact with speakers of that language individuals gain insights into various ways of thinking, living, and understanding the world. This fosters open-mindedness, empathy, and a boundless world across cultures and societies (Balkaya & Akpınar Dellal, 2017). In addition, the research indicated that students could use their imagination and associate words and pictures with what they wanted to express.

In short, it was concluded that social strategies can be successfully employed in foreign language classes to alleviate speaking anxiety. It is an inevitable fact that through these strategies, speaking skills will also inevitably improve. Social strategies are recommended not only for improving speaking skills but also for creating a better classroom atmosphere and fostering camaraderie among students. Furthermore, investigating the impact of social strategies on other basic language skills will make significant contributions to the field. In addition, the long-term impact of these strategies could be the subject of other studies.

Ethic

I declare that the research was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individuals participants included in the study.

Funding

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Pre-service Teachers' Imaginary Creative Approaches to Address Students' Erroneous Understanding of Algebraic Expressions

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Abstract

This study examines the creative responses of pre-service mathematics teachers in their lesson plays designed to address sixth-grade students' misconceptions about algebraic expressions. This research employs a qualitative descriptive research design, involving 78 third-year students enrolled in an elementary mathematics education program. Using lesson plays, the pre-service teachers developed hypothetical lessons that demonstrated how dialogues between teachers and students could unfold in a classroom. The research revealed that the pre-service teachers exhibited pedagogical and mathematical flexibility in addressing students' misconceptions in algebraic expressions. While the participants did not display mathematical and pedagogical originality, they were able to create a variety of hypothetical instructional settings. This study highlights the potential of lesson plays as an effective tool to examine pre-service teachers' creativity and explores various pedagogical approaches in their hypothetical instruction. The findings suggest that teacher education programs should include more opportunities for pre-service teachers to develop their creativity using lesson plays and for preparing them to effectively and originally address students' misconceptions about algebraic expressions.

Key Words

Algebra • Creativity • Lesson play • Pre-service matematics teachers

Introduction

Several research studies have concentrated on students' conceptions and misconceptions about algebraic symbols (e.g., Bush & Karp, 2013; Knuth et al, 2005; Mac Gregor & Stacey, 1997; Usiskin, 1988). In these studies, students' conceptions were classified as (*i*) seeing algebraic letters as mere labels or abbreviations instead of representatives for quantities (Weinberg et al. 2004), (*ii*) believing that different letters in an algebraic expression must signify distinct numerical values, (*iii*) being unable to interpret algebraic letters as generalised numbers, (*iv*) overlooking the algebraic letters and substituting them with actual numbers (MacGregor & Stacey, 1997), (*vi*) finding the concept of 'equality' complex and challenging to grasp (Knuth et al., 2005), and (*vii*) recognizing students' tendency to combine or complete open expressions (Tirosh et al., 1998). One fundamental concept that is a prerequisite for success in algebra is understanding what algebraic symbols represent (National Council of Teachers of Mathematics [NCTM], 2000). In teaching algebraic expressions, teachers employ various approaches such as practicing the manipulation of terms, solving for unknowns, and encouraging students to perceive variables as concise means to express their understanding of varying quantities (Stephens, 2005), improving students' understanding of the equal sign may require changes in teachers' instructional practices (Knuth et al, 2005), using the 'like terms' and the 'fruit salad' teaching approaches (Tirosh et al., 1998). Traditional pedagogical approaches fail to help students develop accurate conceptual understandings of algebraic expressions (Hiebert & Grouws, 2007). However, creative teachers can suggest mathematically and pedagogically innovative ways to support students' learning and address students' misconceptions (Lev Zamir & Leikin, 2011). Teachers need to suggest innovative ways, both mathematically and pedagogically, to nurture creativity in the classroom. Creative teachers can leverage strategies like open-ended tasks and multiple solution problems to address students' misconceptions and promote deeper learning of algebra concepts. By valuing creative thinking, teachers enable students to solve problems in diverse ways, gain new perspectives, and construct robust conceptual knowledge. Creativity is an important concept in mathematics education, though it has often been overlooked in traditional pedagogical approaches (Levenson, 2011; Sriraman, 2009). Recent research has highlighted the value of mathematical creativity - producing unusual yet insightful solutions - in developing students' conceptual understanding and problem-solving abilities (Silver, 1997). By encouraging creative approaches, teachers can support students in developing more flexible and accurate understandings of algebraic expressions. Creativity in mathematics education is an underexplored topic, and teachers' ideas about creativity are limited (Bolden et al., 2010). The limited research on creativity in mathematics education reveals that pre-service and in-service teachers lack creativity in problem-solving approaches (Leikin & Pitta-Pantazi, 2013), instructional strategies (Zazkis & Leikin, 2010), adapting to students' needs (Chamberlin & Moon, 2005), and implementing original tasks beyond the curriculum (Liljedahl, 2016). Using a creative approach when teaching the challenging concept of algebraic expressions to students is considered to be a way to overcome the problems encountered with this concept. In light of the challenges students face in understanding algebraic expressions and the limited creativity demonstrated by teachers and pre-service teachers in mathematics education, Zazkis (2017) provided a valuable insight for the importance of considering the role of teacher educators in fostering creativity among pre-service teachers. By incorporating the lesson play method into the creativity in mathematics teaching model, she highlighted the potential for recognizing and promoting various conceptions of creativity in mathematics teaching. In line with this

suggestion, the present study examined the creative pedagogical approaches of pre-service mathematics teachers in the lesson plays they prepared to eliminate sixth grade students' misconceptions about algebraic expressions. Identifying pre-service teachers' pedagogical approaches to address students' misconceptions will assist teacher educators in revising tasks related to creativity in teacher education. Additionally, the findings may help mathematics teacher educators foster pre-service teachers' creativity in teaching algebraic expressions by incorporating innovative pedagogical approaches to teacher education courses involving the teaching and learning of algebra. Preparing future teachers better with these innovate pedagogical approaches can pave the way for increased student understanding and success in algebra.

Lesson Play

Lesson plays are scenarios that present an alternative to traditional lesson plans by constructing imaginary dialogues between teacher-student or student-student interactions (Zazkis et al., 2009). When creating lesson plays, it is important to focus on student concepts that may arise in the classroom and teaching strategies that will facilitate the intended student thinking (Zazkis et al., 2013). For example, a lesson play could focus on a potential misconception students may have in an algebra lesson, the explanations revealing this misconception, the underlying reasons, and creative teacher approaches to help students overcome this misconception. Relevant literature has documented that lesson play tasks greatly assist pre-service teachers in better understanding mathematics and mathematics teaching (e.g., Shure & Rösken-Winter, 2022; Shure et al., 2022; Zazkis et al., 2013; Zazkis & Zazkis, 2014). Developing a repertoire of lesson plays on various mathematical topics not only supports pre-service teachers' professional development, but also serves as a tool for researchers to examine pre-service teachers' creative pedagogical approaches (Zazkis et al., 2013; Zazkis, 2017). Zazkis (2017) emphasized the potential to acknowledge and encourage diverse understandings of creativity in mathematics teaching by integrating the lesson play method into the Lev Zamir and Leikin's (2011) model of creativity in mathematics teaching. She emphasized that the lesson play task presents opportunities to identify instances of the task designer's mathematical and pedagogical creativity, as well as creative implementation opportunities for teachers using the task. In this study, the aim was to examine the creative pedagogical approaches that pre-service teachers proposed in the lesson plays they created about teaching algebraic expressions.

Creativity in Mathematics Teaching and Algebraic Expressions

The theoretical framework of this research is based on the work of Lev Zamir and Leikin (2011) on creativity in mathematics teaching. This model adopts Torrance's (1974) definition of creativity, characterized by flexibility, originality, and elaboration. The model shows how creativity differs in instructors' descriptions from how it is used in the classroom. Lev Zamir and Leikin (2011) further differentiated between the creativity manifested in teachers' actions, referred to as "teacher-directed conceptions of creativity," and the creativity exhibited in student actions, known as "student-directed conceptions of creativity." Regarding teacher-directed creativity, they identified four key aspects: mathematical flexibility, which they defined as transforming mathematical problems and presenting various problem-solving approaches; mathematical originality, which pertains to the generation of tasks that go beyond the standard curriculum; pedagogical flexibility, which encompasses the adapting to students' needs and

responses; and pedagogical originality, which is characterized by the utilization of diverse instructional settings, strategies, and tools.

According to Lev Zamir and Leikin (2011), creativity in mathematics teaching can be achieved by incorporating problem-solving tasks into classrooms, promoting mathematical discourse, and creating a positive learning environment. Applying these principles to the context of algebra, pre-service teachers can develop pedagogical approaches that go beyond traditional methods to more innovatively engage students in learning and facilitate their understanding of algebraic symbols. While traditional approaches have been criticized for being too rooted in theory and not meeting most students' needs (Abaté & Cantone, 2005), recently there have been calls for reform through more innovative, constructivist-based teaching approaches that promotes conceptual understanding (Chang, 2011; Mokhtar et al., 2010). By drawing on these more innovative principles, pre-service teachers can create instructional approaches tailored to engage today's algebra students. Literature review provides an overview of pedagogical strategies for pre-service teachers to teach algebraic expressions effectively (e.g., Kaput, 1999; Leikin, 2009). One approach to teaching algebraic expressions is through the use of *multiple representations* (Kaput, 1999). Research suggests that engaging students in multiple representations (e.g., graphical, numerical, and verbal) can help them develop a deeper understanding of algebraic concepts (Ainsworth, 2006; NCTM, 2000). For example, pre-service teachers can employ function tables, graphs, and verbal descriptions to illustrate algebraic relationships (Moschkovich, 1999). The utilization of technological tools such as graphing calculators and computer software can also facilitate the exploration of multiple representations (Trouche & Drijvers, 2010). Another approach to teaching algebraic expressions involves the use of contextualized problems (Kieran, 2007). By presenting algebraic concepts within real-world contexts, pre-service teachers can help students make connections between abstract algebraic symbols and their applications (Lesh & Zawojewski, 2007). Research indicates that contextualized problems can improve students' motivation and engagement, as well as their ability to apply algebraic expressions in various situations (e..g., Haines & Crouch, 2001).

Promoting algebraic reasoning through pattern generalization and functional thinking represents another effective pedagogical approach for pre-service teachers (Radford, 2006). By engaging students in activities that require them to analyze and generalize patterns, pre-service teachers can foster their ability to think abstractly and manipulate algebraic symbols (Lee & Freiman, 2006; Warren, 2003). Moreover, focusing on functional relationships between variables can help students develop a better understanding of algebraic expressions and the role of variables in representing real-world situations (Kaput, 2008). Research suggests that providing clear explanations and step-by-step guidance can support students' understanding of algebraic symbols and their manipulations (e.g., Nathan & Koedinger, 2000; Warren, 2003).

Method

Research Design

This research employs a qualitative descriptive research design, known for its intention to offer a comprehensive summary of events (Lambert & Lambert, 2012). This approach is particularly fitting for this study, as it allows for a rich exploration of the creative pedagogical approaches used by pre-service mathematics teachers, investigating the

approaches in which they address misconceptions in algebraic expressions. Within this framework, the study explores the creative strategies of pre-service mathematics teachers by examining lesson plays created by third-year students enrolled in an elementary mathematics education program.

Participants

The research participants were 78 third-year pre-service middle school mathematics teachers ($n_{female} = 69$, $n_{male} = 9$) enrolled in a teacher education program at a university in Turkey. The participants were enrolled in a compulsory mathematics education course titled "Algebra Instruction" during the course of this research. The algebra teaching course consists of three 45-minute lecture hours per week for 14 weeks. In this course, pre-service teachers acquire information about the concepts and the teaching of these concepts in the field of algebra within the secondary school mathematics curriculum (Ministry of National Education [MoE], 2018). The course primarily focuses on the mathematical meaning of the concepts, and then is based on the implementation of activities to be used in teaching the subject in accordance with the grade level. The course proceeded in a student-centered structure, where pre-service teachers participated in activities and held discussions in real teaching environments of the activities. Within the scope of this research, pre-service teachers created the lesson plays at the end of the seventh week of the course, after learning the subject of algebraic expressions. The focus of the research was on what kind of situations pre-service teachers proposed in the context of creativity when their knowledge of algebraic expressions was at a sufficient level.

The selection of participants in this research was carried out using the criterion sampling method (Patton, 2001). This method involves selecting cases that meet predetermined criteria of importance and can be useful for identifying and understanding information-rich cases. The criteria for participation in this research were being a third-year student in the elementary mathematics education program and are currently enrolled in the algebra teaching course. Participants' involvement in the study was voluntary. These pre-service teachers entered the department after taking the high-stakes national examination entitled YKS (Higher Education Institutions Examination). All high school graduates must enter this examination in order to study at a university. After four years (i.e., eight semesters) of education in teacher education programs, the pre-service middle school mathematics teachers earn a Bachelor's degree that licences them to work public or private schools as a mathematics teacher.

It is important to note that these pre-service teachers had not taken any courses directly related to creativity in mathematics teaching. Participants provided informed consent prior to their participation in the study. To guarantee participant anonymity, all identifying information was deleted from participants' scripts and each participant was given a special code. The participants in the study were informed that they could voluntarily withdraw from the study at any time.

Data Collection

Data were collected via the prompts for the lesson play task (Zazkis, 2017). Lesson plays consist of student-student or student-teacher dialogues called prompts (Zazkis et al., 2009). Zazkis (2017) suggests that lesson play tasks can be used in addition to alternative methods such as interviews, observation or lesson planning to examine

the knowledge, skills and creativity of pre-service teachers. Since the creative pedagogical approaches of pre-service teachers were investigated in this research, lesson play tasks were deemed appropriate to carry out this analysis. The prompts in lesson play were developed based on research on students' misconceptions on algebraic expressions (Kieran, 2007; Knuth et al., 2005; MacGregor & Stacey, 1997; Usiskin, 1988; Weinberg et al., 2004). These misconceptions, which were selected to create the lesson play task, were included in the course content as misconceptions that students may have in teaching algebraic expressions in the algebra teaching course. During the algebra teaching course, pre-service teachers discussed the reasons underlying these misconceptions and how they could eliminate these misconceptions. Therefore, it was assumed that pre-service teachers can demonstrate their creativity better when their knowledge about the subject is adequate. These misconceptions demonstrated students' erroneous thoughts on different meanings of algebraic symbols. The prompt was based on Zazkis's (2017) task that states an error, but does not include a reason for this error. The task used as a data collection tool is presented below:

There is a conversation between a teacher and his/her students. There are 25-30 students in the classroom. Three students in the classroom have the following conceptions about algebraic symbols:

Teacher: What is "*a*" in an algebraic expression 3*a*?

Student 1: For example, if 3*a* is equal to 32, then *a* is equal to 2. That is, digit of ones.

Student 2: *a* is the variable. It can represent any number.

Student 3: "*a*" denotes the apples.

The data collection tool asked the participants to develop a lesson play that these prompts could be included in somewhere in the script and to answer the following tasks: a. Choose a creative mathematical task and create a play where these imagined students' answers could be occurred, b. Choose a creative pedagogical approach if your student has a misconception, then choose an approach to overcome your students' erroneous conceptions about algebraic symbols. The task was administered to pre-service teachers at the end of the seventh week of the course at the university, and pre-service teachers' lesson plays were collected after one week on an online platform that belongs to the university. Since pre-service teachers were asked to prepare their lesson scenarios on the computer, an online platform was preferred to collect their lesson plays. There were 78 lesson plays concerning algebraic expressions, resulting in a total of 194 single-spaced pages of data in Times New Roman 12 pt font. All of the lesson plays were prepared by pre-service teachers on A4 paper and included 2-4 photographs of mathematical models explaining the subject. All of the pre-service teachers returned their lesson plays on the due date.

Data Analysis

The data analysis was based on creativity in mathematics teaching framework, concentrating on mathematical flexibility, mathematical originality, and pedagogical flexibility, and pedagogical originality (Leikin, 2013). A qualitative content analysis method was used for data analysis (Creswell & Poth, 2018). This method was chosen to carefully review the lesson plays in order to find codes that emerged from the data. The data analysis process was carried out in several steps. First, the researcher read all the lesson plays carefully to be familiar with the data and

obtain an overall understanding of the content. Then, the lesson plays were re-read, and initial codes were generated based on the codes in the creativity in mathematics teaching framework. After generating the initial codes, the researcher engaged in a constant comparison process, in which the codes were compared within and across the lesson plays (Glaser & Strauss, 1967). The researcher was able to categorize the codes and themes through this procedure and to establish connections between them (Saldaña, 2015). Table 1 provides a summary of the codes and explanations of excerpts from the lesson plays.

Table 1.

Codes and Explanations for Data Analysis

Theme	Code	Explanation
Pedagogical flexibility	1. Adjusting the planned learning trajectory to students' needs and responses	The ability of pre-service teachers to modify their planned instruction based on students' responses and needs during the lesson play.
	2. Creating an instructional setting	Pre-service teachers' ability to design a hypothetical teaching environment that facilitates students' learning and understanding of algebraic expressions, including the use of dialogues, group work, or problem-solving activities.
	3. Switch planning	The ability of pre-service teachers to alter their initial lesson plan during the lesson play, based on hypothetical students' needs, misconceptions, or unexpected situations that arise in lesson plays.
	4. Suiting the content to students at different stages of learning	The ability of pre-service teachers to adapt their hypothetical instruction to accommodate the diverse needs and abilities of students, by providing differentiated tasks or support.
Mathematical flexibility	1. Transforming a mathematical task	The ability of pre-service teachers to modify or adapt mathematical tasks in their lesson plays by changing the numbers, variables, or contexts of the problems.
	2. Using mathematical models	The incorporation of mathematical models (e.g., diagrams, tables, or manipulatives) in the lesson plays to support students' understanding of algebraic expressions and address their misconceptions.

Table 1 provides an overview of the codes, explanations, and example excerpts from the lesson plays that were identified during the data analysis process. The codes are organized under the broader categories of pedagogical flexibility and mathematical flexibility, which emerged from the analysis as the primary dimensions of creativity exhibited by pre-service teachers in their lesson plays. In the analysis of lesson plays, no codes were identified within the categories of mathematical originality and pedagogical originality.

To ensure the reliability of the coding process, two researchers were involved. The primary researcher initially coded the qualitative data derived from the lesson plays. Subsequently, a second expert, experienced in coding both

lesson plays and creativity, independently reviewed 20% of the coded data to ensure consistency and accuracy (O'Connor &Joffe, 2020). Any disagreements in coding process were addressed through discussion and by revisiting the data, aiming to achieve a consensus on data interpretation. Finally, the researcher reported the findings to generate a comprehensive understanding of the creativity exhibited by the pre-service teachers in their lesson plays, and to provide insights into the ways in which they addressed students' misconceptions about algebraic expressions. During the data analysis, each scenario was assigned a number. Once the analysis was complete, examples from chosen scenarios were hierarchically reorganized to maintain coherence in the findings section. Subsequently, examples from six different scenarios were featured in the findings. The findings are presented in the following section with representative excerpts from the lesson plays to illustrate the key themes and categories that emerged from the data analysis.

Results

In this section, we present the results obtained from the analysis of the lesson plays created by pre-service teachers. These lesson plays were examined utilizing the creativity in mathematics teaching framework, with a particular focus on themes of mathematical flexibility, mathematical originality, pedagogical flexibility, and pedagogical originality . The key insights and patterns observed in the data are outlined and discussed below.

Upon analyzing the lesson plays created by the pre-service teachers according to the given task, using creativity in mathematics teaching framework, no findings were identified within the themes of mathematical originality and pedagogical originality. However, there were instances of mathematical flexibility and pedagogical flexibility within the pre-service teachers' lesson plays. Consequently, the pedagogical approaches that the pre-service teachers employed creatively in their lesson plays are summarized in Table 2.

Table 2.

Pre-service Teachers' Creative Pedagogical Approaches in Lesson Plays

Pedagogical flexibility	Mathematical flexibility
Adjusting the planned learning trajectory to students' needs and responses	Transforming a mathematical task
Creating an instructional setting	Using mathematical models
Switch planning	
Suiting the content to students at different stages of learning	

Pedagogical Flexibility

Under the theme of pedagogical flexibility, pre-service teachers displayed four distinct examples of creativity in their lesson plays. These include adjusting the planned learning trajectory to students' needs and responses, suiting the content to students at different stages of learning, and switch planning. The data reveal that pre-service teachers adjusted the planned learning trajectory according to students' needs and responses. In the imaginary script, the teacher began with simpler examples and gradually increased their complexity to assess students' understanding. Here is one of the excerpts from the scripts:

Scenario 1:

Teacher: Let's look at the operations I wrote on the board. First, let's find a in the operation $9 + a = 17$. What is *a*?

Feray: *a* is equal to 8.

Ilayda: 8.

Teacher: Yes, you found it right, *a* is equal to 8. So, what is a in the operation $\begin{array}{r} 5 \\ + a \\ \hline 9 \end{array}$ now?

Şirin: 4.

Beyza: Very easy, teacher, *a* is equal to 4.

Teacher: Yes, these were a bit easy, you are right, Beyza, let's make it a bit harder. What is *a* in this example?

$\begin{array}{r} 21 \\ + 2a \\ \hline 48 \end{array}$

Şirin: *a* is seven.

Beyza: Teacher, it is very easy again, *a* is equal to seven.

Teacher: Yes, *a* is equal to seven. Then, let's see, what is *a* if $43 + 2a = 75$?

İlayda: *a* is three.

Teacher: Why did you say 3? İlayda, can you explain?

İlayda: Three plus two equals five. Then four plus "*a*" equals seven, so *a* is three from here.

Feray: İlayda's answer is wrong, *a* is two.

Teacher: Why do you think it is wrong Feray?

Feray: İlayda is adding the wrong digits. Since the ones digit is 3 and *a*, if three plus "*a*" equals five, then *a* is two.

Teacher: Yes, Feray, you are right that the same digits should be added together. Can you establish the equality you said for the ones digit and for the tens digit?

Feray: Of course, we can. There are four and two in the tens digit. Their sum should be equal to six. But the question says five, I think there is a mistake.

Şirin: No, I think what is written in the question is correct. I think what you said is wrong. The sum of four and two should equal six, but since the answer is seven, three plus *a* should equal fifteen. Thus, *a* is equal to 12.

This excerpt (from Scenario 1) demonstrates that the pre-service teacher selected examples for students to interpret various uses of symbols in the imaginary lesson, using the symbol "*a*" in all of these examples. It is evident that the pre-service teacher initially focused on the use of symbols in arithmetic within the chosen learning trajectory before progressing to their application in algebra. This example falls under the theme of pedagogical flexibility and is the most frequently occurring instance in the lesson plays.

Secondly, pre-service teachers constructed problem situations to enable students to grasp the meanings of algebraic symbols in the scenarios they devised, creating an imaginary teaching environment. The pre-service teacher initiated the scenario with a problem and anticipated potential errors that might arise in a problem situation. To solve the problem, the teacher created dialogues for the student characters, which included various errors such as

treating a variable as a label, adding a number to an algebraic expression, and using place value in a two-digit number. A direct quotation from the sample script is as follows:

Scenario 2:

Problem: "Emre is preparing red and white balloons for the April 23rd celebrations. After starting the process, he takes a break to help Mehmet set up a sound system. At that moment, the number of white balloons is four more than three times the number of red balloons. Given that there are 34 white balloons, how many red balloons are there?"

Teacher: How do you solve this problem?

Student 1: There are 34 white balloons, and 3 times the number of red balloons plus 4 will give this number, so I subtract 4 first. After subtracting 4, 30 is left. Then, I thought I could multiply 3 by a number to get 30. Here, I found 10.

In the second scenario, the pre-service teacher devised a different problem, yet the scenario was similar in terms of creating an imaginary teaching environment. The teacher tackled the students' confusion about the value of variables in various algebraic expressions. A part of the lesson play is as follows:

Scenario 3:

Ayşe: There is "a" in these two operations, but why do the values of "a" differ?

Fatma: Let's first convert the mathematical expression $3a + 23 = 56$ into a verbal expression. Let the number of marbles "a" represent the unknown. "23 more than 3 times Ali's marbles is equal to the number 56". According to this sentence, how many marbles does Ali have?

Ayşe: In this case, Ali has 11 marbles.

Ali: Sir, I don't quite understand.

Both scenarios demonstrate the pre-service teachers' ability to imagine an instructional setting that fosters students' understanding of algebraic symbols in a problem context. By addressing students' misconceptions and encouraging them to engage in thinking about algebraic expressions in different contexts, the pre-service teachers created an imaginary learning environment that promoted students' understanding.

In the pedagogical flexibility theme, another common aspect found in the lesson plays was the use of switch planning. It is observed that pre-service teachers constructed their scripts by initially presenting a mistake in algebraic expressions. They hypothesized that students might make errors in these expressions, such as misunderstanding variables as placeholders. Consequently, they incorporated additional excerpts into their scripts to address and overcome students' mistakes before returning to the algebraic expressions. One example of such a script is as follows:

Scenario 4:

Teacher: I'm going to ask you a question now. What is the answer to this question?

$$\begin{array}{r} 12 \\ +\ 5 \\ \hline \end{array}$$

Burcu: When we add 12 and 5, we get 17.

Teacher: Well, done, you got the result right. So, according to this question, what will be the value of □?

$$\begin{array}{r} 12 \\ +\ \square \\ \hline 17 \end{array}$$

Burcu: Subtract 12 from 17. 5 is written instead of □.

Teacher: Well, done, you got the result right. So, according to this question, what will be the value of □?

$$\begin{array}{r} 1\square \\ +\ 5 \\ \hline 17 \end{array}$$

Burcu: What do I add with 5 to make 17?   **17-5=12**   Accordingly, □ should be replaced by 2.

1□ = 12

Teacher: Well, done, you got the result right. Now let's go back to the question I asked first. What is the value of "*a*" here?

$$\begin{array}{r} 3a \\ +\ 23 \\ \hline 56 \end{array}$$

In this scenario, the pre-service teacher responsible for scenario 4 anticipated that the student might make an error during a two-digit addition operation. The teacher adapted the lesson by simplifying the questions and employing various problem-solving approaches (guiding the student to use addition in the final step of the subtraction operation). This demonstrates creativity in the form of flexibility.

Lastly, in the lesson plays, pre-service teachers demonstrate pedagogical flexibility by suiting the content to students at different stages of learning. In the scenarios, pre-service teachers identified a sequence that accommodated the varying learning levels of students and created their scenarios accordingly. For example, in scenario 5, the pre-service teacher transformed a beginning algebraic problem into another problem and created a new one. The problems, in sequence, are as follows: (*i*) 3 times the number of Ayça's pencils and two more pencils equals 32. Based on this, how many pencils does Ayça have ?(*ii*) Her father gave Ayça a piggy bank for her birthday. Her mother gave Ayça 10 TLs to put in her piggy bank. Her father regularly gives Ayça 3 TLs every day to deposit in her piggy bank. According to this, if Ayça initially had 10 TLs in her piggy bank, how much money will there be in total at the end of 4 days? As the scenario continues, this pre-service teacher gradually guides the script towards a pattern-based solution and anticipates that the student (the character named Ümit) may understand the concept of a variable. The part of the lesson play in which the pattern approach was used is provided below:

Scenario 5:

Teacher: How can we solve this question?

Ümit: Since Ayça puts 3 TLs into her piggy bank in one day, we can multiply 3 by 4 to find out how much she saved in 4 days.

Ceylin: But in the beginning, she already had 10 TLs in her piggy bank. If we add the amount accumulated in 4 days to the initial 10 TLs, we can find the total amount in the piggy bank.

Teacher: So how do we express this mathematically?

Tülin: The initial amount was 10 TLs. We express the amount accumulated in 4 days as 4×3. From here, we can write $10 + 4 \times 3 = 22$.

The teacher writes the solution next to the first question. Then, they proceed to the next step.

Teacher: So how much does Ayça save in total at the end of a week?

Berkay: Since Ayça puts 3 TLs in her piggy bank each day, she will save a total of 7×3 TLs, or 21 TLs, in a week. If we add the initial 10 TLs in her piggy bank to the 21 TLs, she saved in 7 days, we can find the total amount in the piggy bank, which is 31 TLs.

The teacher writes the expression $10 + 7 \times 3$ next to the second question.

Teacher: If we look at the answers to these two questions, can we establish a relationship between them?

Ceylin: We added the initial 10 TLs in both questions.

Ümit: Only the number of days changes. The rest is the same. So, the only difference between the first statement and the second one is that in the first question we write 4 because we express the money 4 days later, and in the other, we write 7 because we talk about it a week later.

The teacher writes the following statements on the board and draws attention to the part that changes as the number of days changes:

1st day: $10 + 1 \times 3$

2nd day: $10 + 2 \times 3$

…

7th day: $10 + 7 \times 3$

Teacher: So, without knowing how many days have passed, can we express the amount that accumulates in Ayça's piggy bank after a certain period of time?

Berkay: The numbers we multiplied by 3 show the number of days passed.

Teacher: Yes. Whatever the number of days passed, I write that number in the blank. Since I don't know how many days have passed in this question, I can replace the unknown with a symbol representing that number. We usually choose that symbol from letters. For example, I can express it as a day: $10 + a \times 3$.

Teacher: What does the number *a* represent here?

Tülin: Number of days. So, if the number of days passed is 10, *a* would be equal to ten.

Teacher: For example, after 70 days, how much will be accumulated in Ayça'ss piggy bank?

Ümit: We can find out that 220 TLs will be accumulated from $10 + 70 \times 3$.

Teacher: Yes, you answered correctly, Ümit.

Teacher: If I use the letter *b* instead of this letter *a*, will the result be different?

The teacher writes $10 + b \times 3$ on the board.

Teacher: I called the number of days past *b*. Can you calculate how many TLs will be accumulated at the end of 70 days?

Berkay: It will be 220 TLs again.

Teacher: Then, I can use whatever symbol I want to express the number of days, right?

Lale: Yes, the result does not change.

Mathematical Flexibility

Another aspect of creativity demonstrated by pre-service teachers was mathematical flexibility. They exhibited two types of creativity within the theme of mathematical flexibility: (*i*) transforming mathematical tasks and (*ii*) utilizing mathematical models.

The pre-service teachers demonstrated mathematical flexibility by altering the problems they used and the numbers in the algebraic expressions within their scenarios. For example, upon examining Scenario 1 mentioned earlier, the pre-service teacher adjusted the numbers and presentation of the operations in the scenarios to convey different meanings of algebraic symbols in the task. It is evident that the choice of the operation $43 + 2a = 75$ is a careful selection. This is because, in this example, the sum of 3 and 2 equals 5, making it appear as though "*a*" is equal to 2. The pre-service teacher incorporated this example into the scenario 1, anticipating that students might make a similar mistake during instruction and basing the scenario on this example. Moreover, a closer look at the first examples generated by the pre-service teacher reveals that the procedures were initially written sequentially before being altered to be shown side by side. This instance exemplifies how pre-service teachers can transform mathematical tasks by changing numbers, demonstrating mathematical flexibility. In another lesson play, pre-service teachers aim to help students' comprehension of the concept of variables and algebraic expressions by changing the numbers in the problems they are working on. This script is also shown in Scenario 5. The teacher asks students to solve a problem and then guides them through the process step by step, allowing them to recognize patterns and eventually understand the concept of variables. In the final example within this category, the pre-service teacher scripted questions that involved altering equations and numbers to help students interpret algebraic expressions differently. The following scenario exemplifies this approach:

Scenario 6:

Teacher: I want you to find the "*a*" in the sum operation below.

$$+\begin{array}{r} 3a \\ 23 \\ \hline 56 \end{array}$$

Student A: When we add the number "a" and 3, it becomes 6. If we add 3 and 3, we get 6.

Student B: When we add 3 and 2, we get 5. So "*a*" should be 3.

Teacher: You got it right. Now let's find "*a*" in the equation given below.

$3a + 23 = 56$

Student C: I think that whatever number I add to 23 will make 56, and if I subtract 23 from 56, I find 33. If $3a$ $= 33$ then $a = 11$.

Teacher: Why is it 11?

Student C: To equalize, both sides must have the same number. The 3's were equal to each other, so the other 11's should be equal to each other.

Teacher: Well, let's change our equation a bit.

$3ab + 23 = 56$

If $a = 11$ in this equation, what would b be?

Student D: I subtract 23 from 56, as my friend did, and find 33.

$3ab = 33$.

a is 11 but we cannot find b.

Teacher: Why can't you find it?

Student D: Because there is no number on the other side that I can equalize.

Teacher: Then, let's examine this example. What is b in this equation?

$4b + 5 = 85$

Student A: I subtract 5 from 85 and find it as 80. $4b = 80$.

Teacher: There is no number that we can equalize from the right side of the equation. What do you do now?

Student C: Yes, it is not equalized, but we can think of it like this. The sum of the four b's is 80. From here, b $= 20$. So, we actually did multiplication here. "What do we multiply by 4 to get 80?" We can think of it as $b = 20$.

In this scenario 6, the pre-service teacher created excerpts by questioning the placeholder meaning of the algebraic expression and then the unknown meaning. She then added a second variable to the algebraic equation and predicted that this would prevent the students from considering the unknown value as a placeholder. In other words, she believed that the students could transform the mathematical task to eliminate the misconception, and she based her scenario on this assumption.

The last creativity indicator used by the pre-service teachers in the scenarios they prepared was the use of mathematical models. To eliminate misconceptions in the lesson play, they preferred to use models in some of their scenarios. For example, in scenario 3, a pre-service teacher stated, "23 more than 3 times the number of Ali's marbles equals 56". He believed that the students would not understand the equation $3a + 23 = 56$ written for this verbal expression, so they structured their scenario accordingly. In this scenario, the pre-service teacher first explained how to use algebraic expressions with models, using a model for algebraic expressions. Then, she directed the students to use the model below to explain the given verbal expression, and as a result, the model shown in Figure 1 emerged at the end of the scenario.

Figure 1.

Model for Algebraic Expressions Used in the Scenario

3 a's + 2 tens + 3 ones = 5 tens + 6 ones

3 a's= 3 tens and 3 ones = 33 —> a= 11
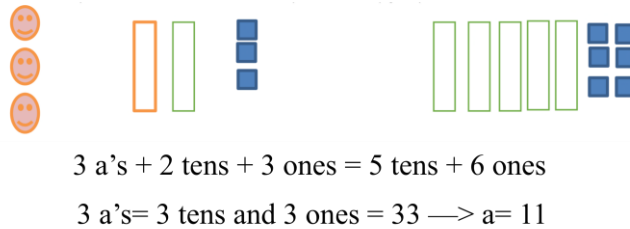
Another example of using models in scenarios is the continuation of the lesson play section described in Scenario 2. The pre-service teacher (who created scenario 2) predicted that a student might have a misconception in the form of 3a + 4 = 7a and continued the scenario by using a model. Here is an example that explains this section of the lesson play.

Student 2: I add $3a$ and 4 to find $7a$. From there, it will be equal to 34.

Teacher: Now, let's revisit the problem we presented at the beginning and consider how to represent it using the model.

The pre-service teacher predicted that the students could draw the model shown in Figure 2 based on this excerpt. They continued with their scenario, believing that the student's mistake could be corrected with the help of the model formation below:

Figure 2.

Example of a Mathematical Model from the Scenario

3 a's + 4 ones = 3 tens and 4 ones
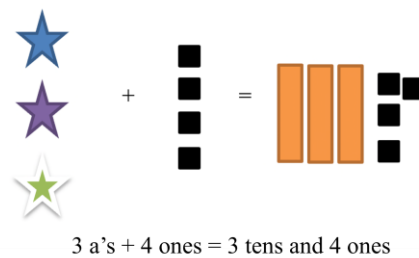
In conclusion, the majority of pre-service teachers in this study demonstrated diverse forms of creativity in their lesson plays, encompassing both pedagogical and mathematical flexibility. They used these creativity indicators to address students' misconceptions and to create instructional environments that promote students' understanding of algebraic symbols. By incorporating various problem-solving approaches, guiding students to recognize patterns, and transforming mathematical tasks, most of the pre-service teachers demonstrated their creativity in designing lesson plays. The use of models in scenarios further exemplifies their creativity in designing hypothetical instructional

design that promote students' understanding of algebraic expressions. Overall, the study provides valuable insights into the ways in which pre-service teachers can use creativity in designing lesson plays that cultivate students' comprehension of algebraic expressions.

Discussion, Conclusion & Suggestions

This study examines the creative responses of pre-service middle school mathematics teachers in their lesson plays designed to address sixth-grade students' misconceptions about algebraic expressions. One of the most important results of this research is that pre-service teachers can create lesson plays in response to the task consists of addressing students' algebraic misconceptions. While the pre-service teachers did not demonstrate creativity in terms of mathematical and pedagogical originality, all were skilled at designing hypothetical lessons. These lessons illustrated potential dialogues between a teacher and a student, highlighting another aspect of creativity. Some unrealistic student responses were also included in the created lesson plays. This result is consistent with the findings of Zazkis (2017). Nevertheless, the task of designing lesson plays empowered all pre-service teachers to envision a teaching environment and explore diverse pedagogical approaches in their hypothetical instruction. Zazkis et al. (2013) argue that lesson play is a tool for exploring pre-service and in-service teachers' mathematical knowledge for teaching. Creativity in mathematics teaching can be considered a component of teachers' knowledge (Chapman, 2013). In this regard, this study demonstrated that lesson play is an effective tool for examining the creativity of pre-service teachers.

Based on the research results provided, it appears that most of the pre-service mathematics teachers exhibited pedagogical and mathematical flexibility in their lesson plays designed to address sixth-grade students' misconceptions about algebraic expressions. Participants adjusted their planned learning trajectory to suit the needs and responses of their students. In the present study, pre-service teachers adjusted their planned learning trajectory and instructional settings based on their students' needs and responses, demonstrating their ability to modify their teaching approaches according to the evolving classroom dynamics (Daro et al., 2011). Compared to studies observing pre-service teachers frequently using similar strategies in algebraic expressions (Kaput, 2008; Kieran, 2007), this research suggests that lesson plays provide a more effective method for these teachers to diversify their teaching approaches. This diversity is essential for addressing the wide range of misconceptions and difficulties students may encounter in the learning process (NCTM, 2000).

It was found that some pre-service teachers also created instructional settings that included dialogues for student characters with various errors to help students understand algebraic expressions. Additionally, the pre-service teachers constructed their scripts by initially presenting a mistake in algebraic expressions and incorporated additional excerpts into their scripts to address and overcome students' mistakes before returning to the algebraic expressions. Some of the pre-service teachers also transformed mathematical tasks by altering the problems they used and the numbers in the algebraic expressions within their scenarios. Most of them also utilized mathematical models in some of their scenarios. Teachers can use model eliciting activities to reveal their models of students' algebraic thinking and promote the development of that model (Hallagan, 2006). Gabina (2019) found that using manipulatives in teaching and learning of algebraic expressions has a positive effect on students' achievement.

Teachers can use multi-representations to express algebra (Jao, 2013). Moreover, the pre-service teachers' ability to construct their scripts by initially presenting a mistake in algebraic expressions and incorporating additional excerpts to address and overcome students' mistakes is reflective of their problem-solving abilities, which is a crucial aspect of effective teaching (Schoenfeld, 2014). By transforming mathematical tasks and utilizing mathematical models, the pre-service teachers demonstrated their capacity to engage students in meaningful learning experiences that offered to their individual needs and misconceptions (Kilpatrick et al., 2001). Kieran (2020) also illustrates the necessity of elucidating the connections between different terms necessary to formulate sentences and create meaning. Contrary to the findings of this research, Even et al. (1993) found that only expert teachers were able to engage students in meaningful learning experiences. These teachers addressed students' individual needs and misconceptions by transforming mathematical tasks and utilizing mathematical models.

Overall, the research suggests that most of the pre-service mathematics teachers can exhibit flexibility in their lesson plays to address students' misconceptions about algebraic expressions. However, it is important to note that no findings were identified within the themes of mathematical and pedagogical originality in this study. This suggests that while most of the pre-service teachers can exhibit flexibility in their lesson plays, further research and training might be needed to help them develop original and innovative teaching approaches to address students' misconceptions about algebraic expressions (Ball et al., 2008). In conclusion, this research contributes to the growing body of literature on pre-service mathematics teachers' creativity in addressing students' misconceptions about algebraic expressions. The findings highlight the importance of developing pre-service teachers' pedagogical and mathematical flexibility to ensure that they can adapt to diverse student needs and respond to the evolving dynamics of the classroom. Future research should explore additional strategies and interventions to support pre-service teachers in developing original and innovative teaching approaches (e.g., the use of lesson plays) to enhance their effectiveness in addressing students' misconceptions about algebraic expressions.

In this study, the creativity demonstrated by pre-service teachers in the lesson plays was examined and illustrated with sample exercises. Although the pre-service teachers displayed no creativity in mathematical and pedagogical originality, the scenarios they created have potential for further development during teacher training, ultimately supporting their creativity (Zazkis, 2017). The findings obtained from this study were based on data collected at a single time. However, pre-service teachers may prepare scenarios that are richer in creativity through repeated processes and lesson plays that they develop in collaborative discussion environments (Shure et al., 2022). Shure et al. (2022) conducted a content validity study for lesson plays to be prepared by pre-service teachers on multiplication and division in fractions. Moreover, Zazkis (2017) emphasizes the importance of designing creative lesson play tasks to enhance the creativity of pre-service teachers. Pre-service teachers can enrich their scenarios and develop their own creativity knowledge through training focused on the theme of originality (Chapman, 2013). In light of these findings, teacher education programs may benefit from incorporating more opportunities for pre-service teachers to develop their creativity through the use of lesson plays and other innovative pedagogical approaches. By doing so, teacher education programs can better prepare future mathematics teachers to effectively address students' misconceptions about algebraic expressions and create more engaging and meaningful learning experiences for pre-service teachers.

Ethics

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Exploring Teacher Autonomy Through Teachers' Perspectives: A Qualitative Case Study

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Abstract

This study aims to explore teacher autonomy from the perspective of teachers. The study has been designed as a case study and carried out using qualitative research approach. The participants consist of 10 teachers in elementary, lower secondary, and upper secondary schools in Milas county of Muğla province in Turkey. The study employed a maximum variation sampling technique to select study participants. Data were collected using a semi-structured interview form developed by the authors. Content analysis technique was utilised in the analysis of the data. The results reveal that teachers have autonomy in teaching process and in professional communication with students and parents, but they lack autonomy in curriculum design, professional development, and professional communication with administrators. Teachers' autonomy is hindered by the centralised curriculum, centralised educational policy, and school administration. Enhancing teacher autonomy requires a flexible curriculum, an autonomy supportive environment, participatory decision-making processes, the empowerment of school administrators, and professional development opportunities for teachers. The results also reveal that increasing teacher autonomy will not only enhance teachers' self-confidence, performance, motivation, and sense of responsibility but also support students' achievements and their learner autonomy.

Key Words

Autonomy • Teacher autonomy • Teacher • Turkish teachers

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Introduction

Decision-making is central to administrative processes. The functioning of educational organisations necessitates making decisions in many areas of education and the structural constraints within the education system influence the decision-making of teachers. It is also known that the effectiveness of education systems depends on their ability to create a respected teaching profession with granted autonomy and authority (OECD, 2014). The success of education systems depends on continuously supporting teachers, providing them with professional development opportunities, and seeing them as central agents in educational decisions (OECD, 2010). Providing teachers with sufficient level of autonomy in areas such as administrative processes, curriculum, teaching process, professional development, and professional communication can make significant contributions to their professionalism, educational outcomes and also to organisational effectiveness. For this reason, distributing power and control and giving responsibility to teachers from the planning process to decision-making and implementation of a task remains an important topic of discussion for educational reforms in various countries.

In a general sense, teacher autonomy refers to educators' control over their actions and job environments (Pearson & Hall, 1993). In another sense, it relates to the teacher's influence, flexibility, power, and authority in areas such as teaching, assessment, school management, and reform (Garvin, 2007). The power and authority associated with teacher autonomy does not simply evoke freedom. This autonomy is built on self-determined rules and regulations as well as on requirements of the teaching profession (Wermke & Höstfält, 2014). Teacher autonomy requires transparency and accountability, as well (Helgøy & Homme, 2007). In this regard, teacher autonomy means that teachers are held accountable for their decisions and that they exhibit their autonomous behaviors to school administrators and senior managers (e.g. ministry, policy makers) within an accountable framework (Wilkins, 2011). Beyond its definition, teacher autonomy comprises an important aspect of teacher professionalism (Helgøy & Homme, 2007; OECD, 2016). This is because professionalism primarily depends on one's ability to exercise autonomy and discretion in their work (Buyruk & Akbaş, 2021). For this reason, autonomy has an important place in distinguishing professions from other occupations (Ingersoll et al., 1997; OECD, 2020a). Furthermore, teachers' authority to make important decisions empowers them to fulfill their roles as professionals (Demirkasımoğlu, 2010). As can be seen, teacher autonomy refers to an accountable professionalisation process characterised by teachers exercising authority and being responsible for their decision-making.

Recent studies highlight that teacher autonomy goes beyond its traditional meaning and focus. In the traditional sense, teacher autonomy is a state of being based on independence through isolationism and alienation (Willner, 1990). According to this perspective, teachers' making decisions independently from colleagues and administrators and acting alone without the need for collaboration is perceived as autonomy (Çolak et al., 2017). However, in organisations where collaboration becomes gradually important, this isolation-based perspective on autonomy is no longer considered untenable (Vangrieken et al., 2017). Therefore, the "isolation" situation in which teachers do not interact with their colleagues and do not receive meaningful feedback from them should not be considered as autonomy. The newer perspective on autonomy centers around collaborative way of decision-making and "professional" independence in job related choices (Willner, 1990; Xu, 2015). Therefore, professional autonomy is a

situation created by solidarity among colleagues, where employees are in charge on the basis of professional ethical principles (Evetts, 2009). Since collaboration has interrelated benefits for students, teachers, and the school as a whole, teachers are expected to act collaboratively (Vangrieken et al., 2017). As seen, there is a shift in the meaning and focus of teacher autonomy from individualist independence to accountable collaboration so that various stakeholders of education could benefit from the potential profits of autonomy granted to teachers.

The scope of teacher autonomy is multifaceted. It could encompass decisions related to administrative tasks, curriculum, instructional methods, and fostering social and academic development, both within the classroom and throughout the school environment as a whole (Gwaltney, 2012). It is also suggested that teachers can be granted autonomy in various areas, including curriculum design, the choice of teaching methods and strategies, classroom management, school administration decisions, and personal professional growth. All of these aspects should be guided by scientific, ethical, and pedagogical principles (Çolak et al., 2017). Such an autonomy can also include school policies and educational planning (Ingersoll, 2007; Ingersoll et al., 1997). According to Friedman (1999), teachers' autonomy-related aspects can include two axes: the decision-level axis and the decision-content axis. The former relates to issues that impact fundamental aspects of education stakeholders' work, such as policy formulation and the establishment of ground rules for professionals within the organisation. The second one is associated with pedagogical issues such as students' needs and problems, relationships with other stakeholders, and curriculum and teaching methods, as well as budget, school working procedures and regulations, and administrational and organisational issues. According to Öztürk (2011), the extent of teacher autonomy can be delineated within a framework that encompasses designing and executing instruction, involvement in administrative procedures, and personal professional growth. Similarly, Çolak and Altınkurt (2017) suggest that teacher autonomy includes various domains, such as teaching processes, curriculum, professional development, and professional communication.

However, the scope and level of autonomy that education systems grant to teachers differs across countries. It is salient that the education systems of countries that are more successful in international exams offer more autonomy to both teachers and schools. For example, education systems that grant schools more autonomy in areas such as student assessments, course offerings, curriculum content, and textbook choices tend to achieve higher results on the PISA (Schleicher, 2018). The school autonomy index, which assesses the autonomy and responsibility of principals, teachers, and school governing boards, confirms that successful countries or regions like China (Macao), Hong Kong, Singapore, Finland, Estonia, and Canada have higher levels of school autonomy (OECD, 2015). Turkey, on the other hand, is one of the countries providing the least autonomy to its teachers. In the OECD's Education Policy Outlook, the country note prepared for Turkey for 2020 indicates that the highly centralised education system is the main problem area in terms of governance (OECD, 2020b). Because of the centralised structure of the education system in Turkey, teachers' autonomy levels in areas such as determining course content, developing curriculum and designing school policies remains well below the OECD average (Schleicher, 2020). Hence, it could be suggested that policy arrangements are quite important in increasing autonomous initiatives and actions of teachers.

In the related literature, numerous research have been conducted on teacher autonomy. Some of these research directly address teacher autonomy (e.g., Strong & Yoshida, 2014; Wermke & Höstfält, 2014), while others

investigate the relationships between teacher autonomy and its correlates like collaboration (Vangrieken et al., 2017), professionalism (Buyruk & Akbaş, 2021; Helgøy & Homme, 2007; Wilkins, 2011), organisational trust (Çolak et al., 2023; Paradis et al., 2019), job satisfaction (Çolak et al., 2017), structural and psychological empowerment (Yorulmaz et al., 2018), professional status (Strong & Yoshida, 2014), and power distance (Çolak et al., 2022). There are also some qualitative studies examining teachers' perceptions towards their autonomy levels as well as the factors affecting their autonomy (Kılınç et al., 2018; Özaslan, 2015). However, in Turkey, no studies have been broached that specifically investigate teachers' perspectives on the limitations, obstacles, and potential outcomes of teacher autonomy. Such studies could provide a deeper understanding of different aspects of teacher autonomy and offer guidance to school administrators and policymakers in taking actions to empower teachers. In light of the aforementioned gap in the literature, the aim of this research study is to investigate teacher autonomy through perspectives of teachers. In alignment with this aim, the following questions serve as the foundation of this study:

1. What are the limits of teacher autonomy according to teachers' perspectives?

2. What are the factors hindering teacher autonomy according to teachers' perspectives?

3. What steps should be taken to enhance teacher autonomy according to teachers' perspectives?

4. What are the outcomes of increasing teacher autonomy according to teachers' perspectives?

Method

Research Design

Qualitative research approach was utilized in the study. The research was designed in the case study model. A case study is the description of a state or the presentation of themes related to a situation by collecting detailed and in-depth information about real life or a limited system through multiple sources of information (Creswell & Poth, 2018). In this study, "teacher autonomy" was considered as a case and various dimensions of teacher autonomy were revealed by analysing the interview data attained from participant teachers.

Study Group

The study group is comprised of 10 teachers working in elementary, lower and upper secondary schools in Milas county of Muğla province in Turkey. In the identification of the study group, maximum variation sampling technique was employed. In this regard, it was planned to include participants from different school types. In addition, special attention was paid to include teachers with different professional seniority and from different branches. The inclusion of teachers from various branches, different professional backgrounds, and diverse school types in the study group enabled to collect comprehensive data on teacher autonomy. This approach also facilitated the exploration of the perspectives of teachers at different levels of autonomy. In this sense, diversity was ensured in terms of participants. Information about the participants and their background is shown in Table 1.

Table 1

Research Participants and their Background

Code	Gender	Seniority (Year)	Branch	School type
T1	Male	34	Turkish Language and Literature	Upper secondary
T2	Female	25	Turkish Language and Literature	Upper secondary
T3	Male	16	Information Technologies	Upper secondary
T4	Male	22	Visual Arts	Lower secondary
T5	Female	13	English	Elementary
T6	Male	23	Mathematics	Upper secondary
T7	Male	26	Classroom Teacher	Elementary
T8	Male	32	Philosophy	Upper secondary
T9	Female	17	Science	Lower secondary
T10	Male	14	Social Studies	Lower secondary

Data Collection Instrument

A semi-structured interview form developed by the authors was utilised in the research. In order to develop the instrument, theoretical explanations in related literature were consulted and the instrument was drafted first. Besides, four field experts were consulted in order to evaluate and improve the draft form. Considering their feedback, the interview form was reorganised and made ready for the implementation. There were a total of five main questions in the interview form. An alternative question was prepared for each original question in case the questions were not sufficiently understood or enough feedback was not received. In addition, probes were prepared to attain an in-depth data from teachers. The instrument's questions can be exemplified as follows: "In what areas do you think you are given autonomy?", "What factors do you believe hinder your autonomous behaviors?", "What steps do you think are necessary for you to act in an autonomous way?"

Procedure and Data Analysis

The data were attained between March and May 2022. Ethics committee approval and institutional permission were obtained for the data collection. Authors held face-to-face interviews with the teachers in a suitable and quiet environment. An appointment was arranged with each teacher who agreed to be interviewed, and authors enlightened them about the scope of the research before the interviews. Participants were asked for permission to record the interviews, and informed consent was obtained. In this regard, a total of 10 interviews were recorded. Modifications to the interview questions were implemented as needed to align with the natural progression of the interview. Emphasis was placed on conducting the interviews in a conversational atmosphere. The length of the interviews ranged from 21 minutes to 61 minutes. The authors subsequently transcribed the audio recordings of the interviews. In order to prevent data loss, all transcripts were compared again with the audio recordings. As a result, a 66 page interview transcript was attained. The data obtained from the interviews were analysed through content analysis.

Content analysis aims to uncover concepts and relationships that can provide explanations for the data. The collected data are conceptualised and organised in a logical manner and themes that represent the data are identified (Yıldırım & Şimşek, 2021). In this regard, the research data were analysed, related concepts were gathered, and themes were formed. When relationships could be grouped under themes, sub-themes were created to present the subject more coherently.

Validity and Reliability

In qualitative research, validity means reflecting the researched phenomenon as it is and in an unbiased manner. Explaining all stages of the research in detail, including direct quotations under themes and expert review can be used to increase validity (Yıldırım & Şimşek, 2021). In terms of validity, the identification of study group, the background of participants, the interview form development process as well as the data collection and analysis procedure were reported in detail. Embedding direct quotations under the themes ensured that the data on which the results were based were conveyed to the reader without adding any interpretations. In addition, the appropriateness of the statements under the themes was evaluated in a meeting involving the authors and a member of faculty with expertise in the field and in qualitative research design. In the so-called meeting, the ability of the themes to reflect the data and the compatibility of the opinions with the theme were discussed and the meeting continued until a consensus was reached. In terms of validity, the formula "Reliability = Agreement / (Agreement + Disagreement) x 100" was utilised (Miles & Huberman, 1994). The data set uncovered 35 thematic conceptualizations in 31 of which the authors were in agreement. Therefore, the reliability rate between the researchers was found to be 89%. To eliminate any disagreement for the uncovered concepts in between authors, consensus meetings were organised and the authors reached an overall consensus on all of the concepts.

Findings

In this research, teachers' views regarding teacher autonomy were investigated. The data attained through interviews with teachers were analysed under four themes. These are (1) Limits of teacher autonomy, (2) Factors hindering teacher autonomy, (3) Steps required to enhance teacher autonomy, and (4) Outcomes of increasing teacher autonomy.

Limits of Teacher Autonomy

Under this theme, teachers' perspectives about the limits of teacher autonomy are included. Based on their views, the limits of teacher autonomy were analysed under two sub-themes: Areas where teachers could exercise autonomy and areas where autonomy is not provided to teachers. The views of the teachers on this issue are shown in Table 2.

Table 2

Limits of Teacher Autonomy According to Teachers' Views

Limits of Teacher Autonomy	
Areas where teachers could exercise autonomy	Areas where autonomy is not provided to teachers
• Teaching process	• Curriculum
o Classroom management	o Determination of subject content
o Selection of methods and techniques	o Selection of textbook
o Use of time	o Assessment and evaluation
o Assignments	• Professional development
o Organisation of subject content	• Professional communication with administrators
• Professional communication with students and parents	

Participants opined that they were autonomous in terms of teaching process and professional communication with students and parents. With regards to teaching process, participants stated that they were autonomous in classroom management, selecting methods and techniques, using time, assignments, and organising subject content (T1, T3, T5, T6, T7, T8, T9, T10). Besides, in terms of professional communication, participants expressed that they were autonomous in their communication with students and parents (T5, T8). The views of some participants regarding the autonomy in the teaching process and professional communication are as follows:

The environment where I feel most free is in my classroom. When interacting with students, you can see that they are open to receiving anything. It makes me feel more comfortable (T7).

We feel free while teaching in the classroom. I also have the autonomy to determine the teaching strategy, decide which approach to use for a subject, and choose the methods and techniques. It's a completely open space for me (T8).

One area where I feel free is my ability to allocate extra time based on the importance of a topic. I have the flexibility to manage the timing myself, and there are no issues in that regard. Depending on the significance of the subject, you can extend, shorten, or change its placement (T6).

... I give project assignments on different subjects to the students in the ... class. This year I gave them a subject outside their own subjects. I am free in this sense (T9).

Some colleagues stick less to the textbook... I don't follow the textbook 100% either. For example, there are 2-3 pieces, I read one of the texts. If there is a good poem or article on that subject in another source, I read it (T1).

We have the freedom to communicate, and I have full control over it. I decide with whom and how I will communicate with the students. Of course, such communication must adhere to the ethical rules of the profession (T8).

To outline the limits of teacher autonomy, teachers also expressed the areas where they could not act autonomously. In this context, participants were of the opinion that they could not act autonomously in curriculum, professional development and professional communication with administrators. In terms of the curriculum, participants stated that they were not autonomous in determining the subject content, selecting the textbook, and in

assessing and evaluating (T1, T2, T3, T5, T6, T8, T9, T10). While some expressed their lack of autonomy in professional development (T3, T8, T10), others stated that they were unable to communicate autonomously with administrators (T4, T6). The views of some participants regarding these issues in which teachers cannot act autonomously are as follows:

We are not free in the curriculum. Not only the curricular framework, but also the content is determined. We have to stick to that content. Therefore, there is no freedom in the curriculum (T8).

Teachers are becoming hesitant to even recommend resources. You can't even select your textbook. There is no certain flexibility in the curriculum (T2).

There are also problems in terms of assessment and evaluation arising from the curriculum. Think that you are teaching the subject, there are extra topics you give, you cannot include them in the measurement and evaluation. Or, there are subjects that you should not teach, but you are required to include them in the assessment according to the level of the students (T3).

In the professional development part, you say that I prepared such and such seminars at the end of the year, and you should go and comply with them, too. In other words, it is a central seminar program. The fact that the content of these seminars is not determined together with the teachers is actually a problem (T10).

We see that most things lose their importance as long as the teacher cannot explain his own problems or report the problem he has in his lesson to a higher authority. I mean, here we are having trouble expressing ourselves freely. Teachers do not have the courage to say, "You are doing this wrong," without fear, thinking that nothing will happen to me, that I will not be expelled from my profession. In other words, where there is no courage to say that this is wrong, it is not possible for the wrongs to be revealed and corrected (T4).

Factors Hindering Teacher Autonomy

The second theme of the study is the factors hindering teacher autonomy. Based on participants' perspectives, the factors hindering teacher autonomy were examined under three sub-themes: Centralised curriculum, centralised educational policies and school administration. The views of teachers on this issue are presented in Table 3.

Table 3

Factors Hindering Teacher Autonomy According to Teachers' Views

Factors Hindering Teacher Autonomy		
• Centralised Curriculum	• Centralised Education Policies	• School Administration
o Centralised learning outcomes		
o Centralised exams		
o Centralised textbooks		

Participants opined that teacher autonomy was hindered by the centralised curriculum, centralised educational policies and school administration. In terms of centralised curriculum, participants expressed that centralised learning outcomes, centralised exams and centralised textbooks hindered teacher autonomy (T2, T3, T4, T5, T6, T7, T8, T9, T10). They also stated that centralised educational policies (T5, T8, T10) and school administration (T2, T3, T5, T6,

T8, T10) hindered teacher autonomy, as well. Some of participants' perspectives on the factors hindering teacher autonomy are as follows:

Teachers in the national education system are never truly free. Everything in the curricular framework, including the learning outcomes... They don't even have the authority to change the methods or to change the level of students in the outcomes... They have no authority to make changes in national education. They do not have the authority to make changes in the curriculum, as well (T2).

In Turkey, there are exams like high school entrance exam (LGS) and university entrance exam (YKS). As long as these exist, it is difficult to talk about teacher freedom. You have to work so that students reaches a certain level (T3).

Course resources we use limit us. Hence, we have to go towards other reference books. Because it is very difficult to prepare for the university exam with the knowledge from these resources.. Or how successful can you be? Yes, books are printed and distributed by the state. I think it is for futile (T6).

It is the same with administrative processes. You have to act according to the legislation. Therefore, we do not have any say in determining the legislation (T8).

Apart from that, the school administration... I think there is a problem because they say this will happen, do it this way. Don't do this, don't do that. For example, the school administrator interferes with your course's assessment and measurement, he is also told this by those with higher authority. There is a situation related to that (T5).

Steps Required to Enhance Teacher Autonomy

The third theme reached within the scope of this research is the steps required to increase teacher autonomy. According to participants' perspectives, the steps required to enhance teacher autonomy were examined under five sub-themes: Flexible curriculum, autonomy-supportive environment, participatory decision-making, empowerment of school administrators, and professional development. The views of teachers on this issue are shown in Table 4.

Table 4

Steps Reqired to Enhance Teacher Autonomy According to Teachers' Views

Steps Required to Enhance Teacher Autonomy
• Flexible Curriculum
• Autonomy-Supportive Environment
• Participatory Decision-Making
• Empowerment of School Administrators
• Professional Development

In order to increase teacher autonomy, participants suggested that a flexible curriculum (T1, T2, T3, T5, T6, T8, T10), an environment that supports autonomy (T1, T2, T4, T5, T7, T10), participatory decision-making (T4, T7, T8, T9, T10), empowerment of school administrators (T1, T3, T4, T7, T10) and professional development (T2, T3, T4, T5, T6, T9, T10) should be maintained. The views of some participants regarding the steps to be taken to enhance teacher autonomy are as follows:

It is necessary to prepare a flexible curriculum in line with the objectives... Teachers must be provided with the opportunity to act freely within this general framework. Learning outcomes should be determined by teachers in accordance with the level of students. How free can the teacher be in a system where even the learning outcomes or textbooks are defined centrally? (T2)

Simply put, teachers need to be provided with the opportunities to teach... All the objectives of national education must be reviewed and revised... When teachers are granted possibilities to teach and live in comfortable institutional culture, the ministry does not need to do anything and success will come by itself (T6).

There will be freedom if the legislation and regulations are created in a participatory manner, from the class passing regulations to the determination of assessment and evaluation principles. Being bound by a rule restricts freedom. But if this rule is created by those who will adhere to that rule, we will ensure self-determination or autonomy as Kant says (T8).

Administrators are quite important. I mean, if there is someone who knows how the school works, how the vocational courses are conducted, this will automatically provide you with freedom. But a person who comes there and has no knowledge starts asking for an account... I think merit is very important here. The one who deserves the most should be the administrator (T3).

I think in-service training of teachers is very important. Teachers' personal development should be supported. What I mention here is not in-service trainings held in the district just for the sake of conversation. Really high quality seminars... There must be something at the level of symposiums held at universities. It must broaden the horizons of teachers. The teachers' horizons will expand so that creativity will come. There will be a motivation for them so that they can bring innovation to the classroom and become a little more free. So, they will be able to say that this is not like this, it can be done like this (T5).

Outcomes of Increasing Teacher Autonomy

The fourth theme reached in the research is the outcomes of increasing teacher autonomy. Based on the teachers' perspectives, the outcomes of increasing teacher autonomy were examined under two sub-themes: Outcomes for teachers and outcomes for students. The views of teachers on this issue are shown in Table 5.

Table 5

Outcomes of Increasing Teacher Autonomy According to Teachers' Views

Outcomes of Increasing Teacher Autonomy	
For Teachers	For Learners
• Increasing self-confidence	• Increasing success
• Increasing performance	• Supporting learner autonomy
• Increasing motivation	• Raising future generations
• Increasing sense of responsibility	

Participants were of the opinion that increasing teacher autonomy would have outcomes not only for teachers but also for students. The participants expressed that increasing teacher autonomy would increase teachers' self-confidence (T2, T3, T4, T6), performance (T2, T6, T8, T9, T10), motivation (T5, T6, T8, T9) and sense of responsibility (T3, T5, T6, T8, T10). The views of some participants regarding the outcomes of increasing teacher autonomy for teachers are as follows:

If a teacher's freedom increases, his/her self-confidence increases, as well. He/she does his/her job with more pleasure, and if there are only three to five students are interested in his/her lesson, he/she can increase this number to 15-20 and increase the success by 100% (T2).

The teacher begins to practise his/her profession with joy. When he/she feels having autonomy and responsibility in the profession he/she enjoys, he/she will begin to conduct what he/she does more consciously. In something he/she does more consciously, he/she will both contribute to himself/herseflf and be more productive. If we talk about the product he/she obtained, in other words "the student", he/she will work more devotedly to make that product (student) better (T10).

The teacher works more comfortably. He/she becomes more motivated. He/she feels valuable. I feel satisfied when I do something different in terms of professional development. The teacher gets happy, eager to learn something else, and can improve himself/herself. Autonomy is a good thing in terms of a profession, I think (T9).

Being free places responsibility on the teacher in the first place. This enables him to make an effort outside of school to acquire the necessary professional competencies... If it was a curricular framework, the teacher would have to do the necessary preliminary work to fill the content of the curriculum... As the area of freedom expands, you impose responsibilities on those who will benefit from that area of freedom. The area of freedom also expands the area of responsibility (T8).

In addition, participants opined that increasing teacher autonomy would have significant outcomes for learners. In this context, they stated that teacher autonomy would increase student achievement (T1, T2, T3, T5, T6, T10), support learner autonomy (T3, T4, T8), and ensure the raising of future generations (T2, T6, T8, T10). The views of some participants regarding the benefits of increasing teacher autonomy for learners are as follows:

Both success and quality of education increase... Students already love the lesson, they already love the school.... A teacher who has broad horizons and loves his/her job also expands the horizons of the students. Students also enjoy everything. In this way, success comes in a pleasant environment (T5).

If the teacher is confident, it will be much different for him/her to manage the students in the classroom or to give them freedom. Students can also express themselves comfortably. If the teacher is free, he/she will give that freedom to the students in the same way. Even if the student may not learn the lesson, at least there will be great benefits for the student in terms of self-realization, self-confidence and self-expression (T3).

The freedom arising from the curriculum will first affect the teaching process in the classroom. The benefit it will provide to teachers in the teaching process is that we will create the desired social structure in a more liberal environment. In other words, we will be able to acquire a generation that questions and criticises (T8).

Discussion, Conclusion & Suggestions

Within the scope of this research, teachers' views regarding teacher autonomy have been investigated in a multidimensional manner. The results reveal that teachers can act autonomously in specific areas, including the teaching process and professional communication with students and parents, but they face limitations in other areas such as curriculum development, professional development, and communication with administrators. It is noteworthy that their autonomous behaviors are hindered by structural factors (central curriculum and instructional programs) and school management. In order to increase teachers' autonomy, curriculum should be designed flexibly, qualified professional development opportunities should be offered to teachers, and school administrators should provide

necessary autonomy supportive conditions. Furthermore, the research has revealed that teacher autonomy has positive outcomes for both teachers and students.

As part of the first objective of the research, the limits of teacher autonomy in Turkey have been identified from the perspectives of teachers. Following semi-structured interviews conducted with teachers, the limits of professional autonomy have been examined under two sub-themes: areas where teachers could exercise autonomy and areas where autonomy is not provided to teachers. Based on their perspectives, the areas in which teachers exercise autonomy include the teaching process (classroom management, selection of methods and techniques, time management, assignments, and organising curriculum content) and professional communication (communication with students and parents). Recent research in Turkey regarding teacher autonomy also highlights that teachers perceive themselves as autonomous in teaching process and professional communication (Çolak et al., 2017; Ertürk, 2023; Yazıcı & Akyol, 2017; Yorulmaz et al., 2018). Indeed, in Turkey, the meaning attributed to autonomy is closely associated with classroom autonomy. Despite the centralised education system and its inherent constraints, teachers can still find areas of autonomy within their classrooms. This is because the classroom environment and the decisions made within it are largely under the control of teachers. The areas where teachers do not have autonomy are the curriculum (determining the content, selecting textbooks, and assessment and evaluation), professional development, and professional communication (communication with administrators). Two main factors could be asserted to have influence on the limits of teacher autonomy. The first is the centralised education system. Because of the centralised structure of education system in Turkey (OECD, 2020b), teaching actors are not granted autonomy in areas such as determining course content, curriculum development, and designing school policies. However, a partial autonomy is granted to teachers in terms of the selection of methods and strategies employed during lessons (Çolak & Altınkurt, 2017; Eurydice, 2008; Schleicher, 2020). The research results also confirm this fact. The second factor influencing teachers' autonomy areas is neoliberal education policies. As a result of the influence of neoliberal policies on education since the 1980s, teachers' influence on the education process and curriculum has been weakened (Çolak et al., 2022). Through neoliberal education policies, teacher roles is redefined within "new professionalism" and greater control and accountability have been imposed on teachers (Robertson, 1996, 2010). The concept of "new professionalism" is characterised by an approach rooted in elements such as management, standardisation, assessment, and performance evaluation (Evetts, 2011). This approach refers to a process where autonomy of workers is limited, but accountability and performance controls over them increase (Evans, 2008; Robertson, 2010). Under the framework of this "new professionalism", the control over teachers is increased, their intellectual roles are neglected, and they are expected to act as qualified technicians (Buyruk & Akbaş, 2021). As seen, both the centralised structure and the implemented neoliberal education policies significantly limit teachers' autonomy.

The second objective of this study is to determine the factors hindering teacher autonomy. The results indicate that teachers believe their professional autonomy is hindered by central curriculum (central learning outcomes, central exams, and central textbooks), central education policies, and also by school management. As previously referred, the centralised structure of the education system limits the professional autonomy of teachers (OECD, 2020b; Schleicher, 2020). Relevant research indicates that a significant problem of the education system in Turkey is

the overly centralised organisational structure and the education process regulated by central authorities (Çolak & Altınkurt, 2017; Yılmaz & Altınkurt, 2011). Additionally, the centralised approach tends to tightly control educational actors (Öztürk, 2012). When all decisions regarding education are made by the central government, teachers cannot go beyond being practitioners and have difficulty in revealing their potential. Research results reveal that teachers' autonomy is also restricted by the school administration. This might be associated with the highness of organisational power distance. Organisations characterized by a high power distance tend to exhibit general traits such as a rigid hierarchical order and a strong inclination for control within an excessively centralised structure (Hofstede, 2001; Hofstede et al., 2010). Research on organisational power distance in Turkish educational institutions indicates that it tends to be at a medium level or higher (Çolak et al., 2023; Özten, 2023; Yorulmaz, 2021). Furthermore, it reveals negative correlations between organisational power distance and teacher autonomy (Çolak et al., 2022, 2023). In other words, the more organisational power distance increases, the less teacher autonomy is granted. Therefore, in schools where organisational power distance is high, the control-oriented manners of school administrators restrict the autonomy of teachers.

As part of the third objective of the research, the steps required to enhance teacher autonomy were identified according to teachers' opinions. Interviews with teachers reveal that a flexible curriculum, an autonomy-supportive environment, participatory decision-making, empowerment of school administrators, and professional development are necessary to increase teacher autonomy. Related research results also reveal that teachers feel less autonomous in the field of curriculum and professional development while they desire to be autonomous in these areas (Çolak & Altınkurt, 2017; Tokgöz Can & Bümen, 2021; Yazıcı & Akyol, 2017; Yorulmaz et al., 2018). Since the central education program does not offer flexibility to teachers, teachers can make adaptations to the program only to a very limited extent, without disclosing it in their plans (Tokgöz Can & Bümen, 2021; Yazıcılar & Bümen, 2019). In this sense, teachers demonstrate limited autonomy behaviors in the implementation of curriculum by taking risks and assuming substantial responsibility (Çolak & Altınkurt, 2017). On the other hand, professional development is a necessity for teachers to act autonomously (Haapaniemi et al., 2021). In other words, for teachers to make autonomous decisions in line with educational goals, they must be competent in their field. However, teachers may perceive a lack of autonomy in their professional development. This perception arises from the fact that in-service teacher training in Turkey is typically centrally planned and executed. However, this prevents in-service training programs in Turkey from being adapted to local teacher needs (Yolcu & Kartal, 2017). When teachers who do not feel autonomous in terms of professional development cannot find an autonomy-supportive environment in their schools, their areas of autonomy narrow further. However, Darling Hammond et al., (2017) emphasise the key value of both teachers' professional development and educational systems' creating environments where teachers can employ their skills effectively for the overall effectiveness of education systems. In the case of schools, the school administrators are the main actors responsible for ensuring such an environment. Considering this, it is crucial that they are first and foremost qualified. In addition, as Yukl (2006) stated, school administrators' displaying transformational leadership characteristics based on empowering their employees and directing them to think as "subjects" will make significant contributions to teachers' autonomy.

The final purpose of the study is to reveal the outcomes of increasing teacher autonomy based on teachers' perspectives. Teachers think that increasing teacher autonomy will enhance teachers' self-confidence, performance, motivation, and awareness of responsibility, and that it will increase students' achievements and support learner autonomy. As seen, there are various benefits of supporting teachers' autonomy. Furthermore, relevant research confirms that an increase in teacher autonomy will enhance their self-efficacy (Skaalvik & Skaalvik, 2014; Valckx et al., 2020) and strengthen their motivation (Fradkin-Hayslip, 2021; Wu, 2015). Undoubtedly, the advantages of teacher autonomy extend beyond the findings of this study. Teachers who have control over their work feel that they work in a more creative environment, can put their skills to work more easily, and achieve greater satisfaction in their profession (OECD, 2020a). For this reason, teachers highly value autonomy as a favourable aspect of their work environment, and they perceive that it contributes to their job satisfaction and professional status (Pearson & Moomaw, 2005; Strong & Yoshida, 2014). Teachers who are granted more autonomy could organise the teaching process in line with the needs of the students, which contributes ensuring their students achieve greater success. Ayral et al.'s (2014) research conducted with PISA exam data also confirms that teacher autonomy has been associated with improved student achievement. Moreover, it is a prerequisite in terms of learner autonomy (Little, 1995). Given that teachers are responsible for fostering learner autonomy (Yazıcı, 2016), it is reasonable to suggest that supporting teacher autonomy is essential for them to fulfill this responsibility.

Drawing from the research findings, some recommendations could be offered for promoting teacher autonomy. In Turkey, there is a need for legal regulations to guarantee teacher autonomy. For teacher autonomy, teachers must be given rights through laws and regulations. Teachers can thus reflect their experience and expertise to student needs at the local level. School administrators can ensure teachers' participation in decisions regarding school policies and contribute to teachers' revealing their potential by creating an open school climate. However, it is quite important that teachers are given legal rights within the framework of the legislation. Hence, school administrators can play a more active role in creating an environment that supports teacher autonomy.

As with other studies, this research has some limitations. The limitation of this research is that the research data have been collected from teachers working in Milas county of Muğla in Turkey. Because of the higher seniority of teachers in this region, the study have not included teachers who are new to the profession. Future qualitative research studies on teacher autonomy could be designed including teachers from different regions with various characteristics. Conducting such research with various teachers in different regions and countries can contribute to an in-depth understanding of teacher autonomy. In addition, future research could be structured to reveal the relationships between teacher autonomy and various variables, including learner autonomy, job satisfaction, organisational commitment, organisational citizenship, and teacher empowerment.

Ethic

Ethics committee approval was obtained from Muğla Sıtkı Koçman University Social and Human Sciences Research Ethics Committee (Date: March 05, 2022, No: 36). Also, the authors declare that the research was conducted in accordance with the ethical standards of the institutional and/or national research committee and with

the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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An Application Based on the 5E Learning Cycle Model Supported by Concept Cartoons with Primary Pre-Service Teachers*

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Abstract

The study aims to examine the effect of concept cartoon supported lesson plan development practices based on the 5E learning cycle model on the non-routine problem solving skills and attitudes towards mathematics teaching of primary pre-service teachers, to determine the level of problem construction, to evaluate the texts in the problems constructed with concept cartoons developed by primary pre-service teachers in terms of text writing success level and to reveal their opinions about the practices. The study utilized a nested design, which is a mixed-method research approach, and employed a convenient sampling method for participant selection. Data collection was carried out using the attitude towards mathematics teaching scale, problem solving scale, interview form, and lesson plans developed by primary pre-service teachers. The data were evaluated by content analysis, t-test for related samples, descriptive analysis, progressive scoring scale, problem posing skills scoring key, grading scale. Significant enhancements in attitudes toward mathematics teaching were observed in favor of the post-test, with opinions categorized into six distinct groups, highlighting challenges encountered during the evaluation phase and the process of problem posing. It was ascertained that the overall level of achievement in text creation was generally deemed satisfactory.

Key Words

Analysis of language mistakes • Concept cartoons • 5E • Pre-service classroom teachers • Problem solving

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Introduction

The ability to solve problems remains a crucial and vital talent in fields other than mathematics despite being one of the goals of the primary school mathematics curriculum (MoNE, 2018). It is important to develop these abilities during school hours, especially in primary school, if someone wants to work in the business sector and can think interdisciplinarly, solve problems, and use 21st-century talents. The primary school mathematics curriculum aims to cultivate students' ability to express their ideas and arguments with clarity in the context of problem-solving, as well as to equip them with the competence to discern deficiencies or omissions in the mathematical reasoning of others. Consequently, prospective instructors of the subject must exhibit an awareness of this imperative, as underscored by the Ministry of National Education (MoNE, 2018).

Math operations by themselves are insufficient to develop this skill. In this situation, it is important to practice addressing non-routine and verbal problems as well as routine ones during the learning process. It is also important to give the necessary studies so that students can develop their problem-solving techniques by following the problem-solving procedures. All educational levels consider problem-solving as a learning activity (Jonassen, Howland, Moore, & Marra, 2003; Lazakidou & Retalis, 2010). Even though it is a crucial task, research indicates that most students struggle to use their mathematical understanding to solve issues, particularly those that involve reading comprehension. Some research has examined the mistakes or challenges that students run into when answering word problems, highlighting the preponderance of linguistic-based problems (Fatmanissa & Kusnandi, 2017). For example, "identifying keywords, using vocabulary, analyzing long sentences, and understanding the written context" are linguistic elements that can make it difficult to understand word problems (Gafoor & Sarabi, 2015; Seifi, Haghverdi, & Azizmohamadi, 2012). As posited by multiple authors (Lamb, 2010; Phonapichat, Wongwanich, & Sujiva, 2014; West, 1977), the most formidable impediment hindering students' proficiency in mathematical problem-solving resides in their challenge to grasp the intended meaning embedded within the textual representations. This prevents them from even beginning the process of problem-solving. Reading comprehension is considered a factor directly related to the structure of the problem, which is a critical factor for beginning the problem-solving process and improving problem-solving skills. According to a study on factors influencing mathematics studies, reading is the most important element (Jiban & Deno, 2007; Lamb, 2010). According to Durkin (1993), reading comprehension is the process of developing a mental image of a text. According to Schnotz and Bannert (2003), mathematics problems are typically texts with discrete features like tables, diagrams, or formulas. Consequently, the conceptualization of reading comprehension can also be regarded as a subsidiary competency essential for formulating a coherent model, as a proficient comprehension of written material is imperative for the organization and elucidation of presented content, as noted by Krawitz, Chang, Yang, and Schukajlow (2022). Schleppegrell (2007) accentuated the significance of engaging with language in the construction of knowledge, a process intrinsic to mathematical endeavors such as teaching and problem-solving. This entails the utilization of diverse linguistic modalities encompassing mathematical symbols, oral discourse, written communication, as well as various semiotic systems such as graphical representations and diagrams. Language provides the reader with contextual information about the mathematical situation to be addressed. This connection is formulated in oral language in the classroom. Thus, written language, mathematical, symbolic expressions, visual representation, oral

language, grammatical patterns, technical vocabulary, dense noun phrases, verbs to be and to have, conjunctions with technical meanings, etc., work together to construct the meaning with which the teacher and students interact when discussing the problem. Schleppegrell (2007) points out that students should be able to use technical vocabulary in meaningful language patterns in mathematics and argues that it is not enough to know only mathematical words such as "more, less, as much"; students should also learn the language patterns associated with these words and how they form concepts in mathematics. Among the linguistic challenges, particular emphasis is placed on the multiple semiotic constructions of mathematics, the dense noun phrases involved in relational processes, and the literal meaning of conjunctions and implicit logical relations that connect elements in mathematical discourse. It also states that research on pedagogical practices supports the development of mathematical knowledge by paying attention to how language is used and suggests strategies for moving students from informal and casual ways of talking about mathematics to more technical and precise processes of meaning-making. Thus, learning mathematics is not only a matter of manipulating symbols but also of understanding how different systems interact to construct meaning. Both linguistic and numerical complexity contribute to the difficulty in solving verbal problems. Researchers working in this area have observed that even in the related fields of linguistics and mathematics, some aspects of the process have been studied comprehensively while others have been neglected. For example, they observed that semantics and discourse structures are often studied in the context of the complexity of verbal problems, but systematic syntactic manipulations are rare (Daroczy, Wolska, Meurers, & Nuerk, 2015). Given that word problems do not present students with a straightforward mathematical expression, their resolution necessitates the undertaking of intricate procedural steps. These steps include reading, comprehending, transforming into a mathematical expression, processing the mathematics, interpreting the result according to the given context, and evaluating the result (Fatmanissa & Kusnandi, 2017; Reys, Lindquist, Lambdin, & Smith, 2008; Verschaffel, Van Dooren, Greer, & Mukhopadhyay, 2010). Verbal problems are problems that take place in real-life contexts (Verschaffel et al., 2010). They require students to read, comprehend, and make mathematical connections to solve the problem. Despite their real-life context, word problems are coded based on the language and symbols of mathematics (Reed, 1998). Consequently, students' interpretation and comprehension of linguistic components within word problems are subject to the influence of the mathematically situated context. Language serves as a cognitive instrument, and an array of studies has underscored the substantial contribution of the interplay between procedural expertise and linguistic aptitude in mathematics to the process of conceptual advancement, as exemplified by the work of Aiken (1972). Thought is not only expressed in words; its existence is revealed through words (Vygotsky, 1978). Therefore, a student working on a problem alone solves the problem based on prior learning and existing mathematical knowledge. However, a student who solves a problem with the help of friends or a teacher can interactively construct mathematical meanings. This interaction, characterized as the zone of proximal development in the context of learning, represents a phenomenon that occurs as students collaborate in the pursuit of a shared task, in accordance with Vygotsky's seminal work in 1978. Language, communication, problem-solving, and mathematical thinking cannot be separated from each other in any mathematics course. In problem-solving, language is important in terms of verbal representations and plays a role as a tool for mathematical thinking (Khalid & Tengah, 2007). The most important reason for students' poor performance in solving verbal problems is their inability to understand the problems. Although some teachers resort to teaching using keywords, this is known to have harmful consequences

(Clements, 1999). The language system and its function is to organize the choices of mathematical symbols and visual representations. If there are problems in understanding the system, this will lead to a lack of understanding of the problems due to linguistic features. Hence, in order to surmount linguistic challenges encountered in the resolution of such problems, it is imperative not to disregard the linguistic attributes inherent in these problems, as emphasized by Fatmanissa and Kusnandi in their study (2017). The instructor's role within the context of solving verbal problems is multifaceted. This is because they try to guide their students towards a familiar solution either based on their own experiences or by utilizing the contexts of the problems they have solved before. At the same time, teachers have the task of carefully selecting from a variety of problem types, as well as gradually modifying problems according to their level of difficulty. To find out what students know and understand, they allow them to talk or write about how they solved the problems. This is not only important for the development of students' problem-solving skills but also valuable for encouraging them to construct their problems (Roche, 2013). In the problem-solving process, teachers need to provide sufficient context for students to see the problem (Monroe & Panchyshyn, 2005). In this process, reading comprehension and linguistic features in the problems presented play an important role in conveying the message. It is important that teachers, who are in charge of providing these skills to students and planning and executing the process, are competent in terms of both problem-solving and language skills. For this reason, for students to make sense of mathematics and for the problem-solving process to be carried out healthily, it is necessary to ensure that students talk and interact with each other in the mathematics classroom, take an active role, and carry out activities and studies that will enable them to develop skills in language and reading comprehension. This is attributed to the fact that language functions as an intermediary link connecting the genesis of a problem and the subsequent processes involved in its resolution. Language is divided into two: receptive language, which is the ability to understand what is said, and expressive language, which is the ability to communicate with the knowledge and use of the spoken language (Deniz & Gönen, 2021, p. 1378). At the same time, from a linguistic point of view, a text is a series of sentences that follow each other and form sequential and meaningful wholes (Günay, 2003). Therefore, it is necessary to know that a mathematical expression is also a text, and the expressive language skill must be used competently to be perceived correctly and clearly by the student, to make the thinking process effective, to develop the solution strategy appropriate to the problem statement to be explained and to reach the result.

In the most basic sense, the process of producing written texts takes place in three stages. These are planning, writing, and revision. Bayat (2019, p.4), while describing the planning stage, says that the person writing the text should have a certain amount of knowledge about the subject and should reformat this knowledge by using his/her thinking ability. If the planning stage is completed correctly, the second stage, the writing stage, begins, in which thoughts are transformed into written text. The author of the text is expected to proficiently utilize their preexisting linguistic foundation in a functional manner, effectively transposing their cognitive ideas into a coherent and intelligible format, replete with grammatical structure and an appropriate array of lexical elements. Finally, in the revision stage, it is observed and checked whether the written text is fully comprehensible, linguistically, and lexically adequate, and in harmony with the plan, and if there are errors, the problem is corrected by going back to the stage where the problem originated. When all stages are completed, a text is produced.

It is expected that the concept cartoons and problem statements created by primary pre-service teachers within the scope of this research will be designed by taking into account the specified elements. These texts, which were produced after the correct completion of this process, were evaluated analytically. In analytical evaluation, there are some features that the literary text produced should have, and the text is analyzed in specified sections, and each section is evaluated separately through grading. The Analytical Grading Scale, originally formulated by Weigle in 2002 and subsequently adapted to the Turkish context by Ülper in 2019, served as the instrument employed for the examination of the texts generated in this research endeavor. The overarching objective encompassed the assessment of the concept cartoons and problem statements crafted by pre-service teachers within a comprehensive framework. The five subcategories determined within the scope of this evaluation are content (the level of knowledge about the subject, being understandable, being well developed, including details about the subject), organization (fluency in expression, clearly determined and organized thought transfer, coherence with logical sequence), vocabulary (the level of vocabulary possessed, The following are defined: language use (level of originality and sophistication in sentence construction and expression disorder), mechanics (proficiency in spelling, punctuation, and paragraphing, and spelling).

Teachers' duties and responsibilities are becoming more complex over time due to the technically, economically, socially, and politically changing world. Due to changing needs, teachers have to face new methods of technology, motivation, teamwork, differentiation, classroom management, and assessment links with parents (OECD, 2009, p. 62). Therefore, teachers should raise individuals with problem-solving skills as decision-makers in the learning-teaching process (from planning to evaluation). Within this context, a fundamental imperative of teacher education lies in the cultivation of educators' problem-solving proficiencies. In educational settings that prioritize student-centered methodologies, the pedagogical paradigm revolves around experiential and hands-on learning, fostering independent problem-solving. Such a pedagogical approach not only engenders lasting comprehension but also empowers students as active participants in the learning milieu. The constructivist learning approach has been one of the most effective theories in mathematics teaching as in other teaching processes. Constructivism, which is a theory about how knowledge is formed and how people obtain knowledge, is related to the nature of knowledge and the way it is obtained. In this context, it is known that many student-centered approaches and strategies are used. Concept cartoons are one of the strategies based on constructivism. Concept cartoons are used as a strategy that activates students' ideas and enables them to make connections with their previous learning. Students' understanding of knowledge can be improved in learning environments supported by concept cartoons (Naylor & Keogh, 2013). Because the ideas conveyed through cartoons are easily understood with the movement of the cartoon character (Subhan & Lilia, 2010). Several studies have indicated that pedagogical utilization of concept cartoons yields several advantageous outcomes, including enhancements in students' discourse proficiency (Naylor & Keogh, 2013), augmentation of the enjoyment factor in the learning process (Narayan, 2016), a favorable impact on students' attitudes and enthusiasm (Kaptan & İzgi, 2014), and a marked increase in student academic achievement (Jamal, Ibrahim, & Surif, 2019). With a concept cartoon, many complex thoughts that occur throughout life can be explained with a picture or drawing. Concept cartoons are drawings that visually represent an idea or symbols and should often be supported by the use of strong language. In this context, cartoons can be effective in overcoming the difficulty of

explaining a complex or abstract statement simply and effectively. Naylor and Keogh (2013) list the contributions of concept cartoons to students in the teaching process: a. It prevents students who lack confidence from experiencing anxiety and fear in the scientific process because it is based on everyday life situations that do not appear to have scientific content, b. It offers alternative perspectives on the topic being discussed, including scientifically acceptable perspectives, c. Although most concept cartoons contain scientific ideas about the problem situation in everyday life, they can affect how the problem is interpreted and create the opportunity to present more than one scientifically acceptable alternative, d. To encourage the students to explore the alternative ideas they have, the students were given a clue that there may be more than one idea to solve the problem in question through empty speech bubbles that have not yet been dialogued, and since all alternative points of view have equal status in the process of creating concept cartoons, students with low self-confidence level were allowed to voice what they think. Consequently, in instances where misconceptions arise, the conveyance of such erroneous notions through the caricatured character, rather than originating directly from the student, fosters an environment that mitigates potential hesitancy or embarrassment associated with the articulation of their perspectives, regardless of their accuracy. Concept cartoons are additionally harnessed as a potent means to interrogate and address students' misconceptions.

In many studies, concept cartoons have been used to teach difficult or complex concepts encountered in the learning process to students more easily and understandably (Topkaya, 2016), to provide an effective classroom discussion environment (Bing & Tam, 2003), and to provide a student-centered teaching process unlike the traditional teaching model (Altun, 2009). Simultaneously, within the constructivist paradigm that prioritizes student engagement, the focal point of pedagogy centers on the learner. The attainment of meaningful learning transpires when students adeptly cultivate efficacious strategies for navigating and resolving problem-laden scenarios. Such situations increase student motivation and offer students the opportunity to experience pleasure and satisfaction in problem-solving (Karagiorgi & Symeou, 2005). Concept cartoons are of great benefit to students at this point. Problem-solving is an important component of mathematics education. Problem-solving provides an environment for students to reflect on their ideas about the nature of mathematics and to develop a relational mathematical understanding (Lester, 1994). As students solve mathematical problems, they discover ways of mathematical thinking outside the mathematics classroom and gain problem-solving habits and confidence. In mathematics education, problem-solving is seen as a skill that should be taught, a goal for mental development, and a teaching method (Brown, 2003; NCTM, 2000). Since the importance given to problem-solving has become widespread, it has become a necessity for both pre-service and in-service teachers to have a common understanding of the importance of problem-solving in mathematics education. Nonetheless, the efficacy of initiatives to reform curricular content is contingent upon the degree of receptivity exhibited by educators towards the newly adopted curricula. Should teachers, who function as the executors of these curricula, not fully internalize the significance of problem-solving, such reform endeavors may ultimately prove unsuccessful. De Mesquita and Drake (1994) showed that there is a direct relationship between teachers' perceptions of innovation and the success of innovation. Therefore, teachers and pre-service teachers, who are expected to have some responsibilities in the reform process, should be examined in terms of their knowledge, skills, and beliefs about the necessity of innovation. In this direction, the scope of this study is to reveal the knowledge and skills of pre-service teachers about non-routine problems and solution

strategies, to design teaching materials using concept cartoons, one of the innovative teaching approaches for the development of these skills, and to examine the effect of these materials.

Constructivism, which is based on the assumption that learning is a product of the structuring of the mind, requires individuals to take more responsibility by actively participating in the learning process (Kılıç, Karadeniz, & Karataş, 2003). Students who actively participate in the learning process develop strategies by trying different solutions to the problem situation presented to them and increase the permanence and meaningfulness of learning. The establishment of learning environments grounded in the constructivist pedagogical framework, coupled with the incorporation of multisensory modalities within the learning process under consideration, augments the effectiveness of information structuring within students' cognitive faculties.

Concept cartoons, which we encounter in this process, were created for the first time in 1991 by Naylor and Keogh (2013), based on the constructivist approach, in 1992 "to develop an innovative teaching and learning strategy that takes into account the views of learning in constructivist science" (Keogh & Naylor, 1999; Stephenson & Warwick, 2002) and the cartoons, which were designed primarily for students aged 9-13, were included in the learning environment in primary and secondary education with the expansion of the studies (Stephenson & Warwick, 2002). Most mathematical concepts are abstract concepts that require high-level cognitive activity. Studies conducted in this direction have revealed that the constructivist approach is effective in helping students construct these concepts in their minds and adapt to abstract mathematical concepts easily. Concept cartoons have been developed as an innovative learning and teaching strategy based on the constructivist learning approach. It is known that concept cartoons have positive effects on mathematics teaching, developing mathematical thinking, creating brainstorming and discussion environments, and writing mathematical problems. It is thought that concept cartoons will be effective in improving the skills of primary pre-service teachers who are known to have problems with non-routine problem-solving skills. In this study, as researchers working in the field of Turkish and mathematics, research was conducted to provide a different perspective on the grammatical and numerical aspects related to the problem statement and solving process of primary pre-service teachers as well as their interaction in educational situations based on the 5E learning cycle enriched with concept cartoons and adopting the constructivist learning approach. In this direction, the aim is to examine the effect of lesson plan development practices based on the 5E learning cycle model supported by concept cartoons on the non-routine problem-solving skills and attitudes towards mathematics teaching of primary pre-service teachers to determine their problem statement levels, to evaluate the texts in the problems established with concept cartoons developed by primary pre-service teachers in terms of content, organization, vocabulary, language use and mechanics, and to reveal their opinions about the teaching practices. In this context, the research problems were determined as follows:

1. How are the problem-solving skills of primary pre-service teachers after the lesson plan development practices based on the 5E learning cycle model supported by concept cartoons for teaching problem-solving steps and strategies?

2. What is the level of problem statement skills of the problems posed by primary pre-service teachers in the concept cartoons developed by considering problem-solving steps?

3. What is the level of success of the texts in the concept cartoons prepared by the primary pre-service teachers and the texts in the problems they set up?

4. Do the practices of developing lesson plans based on the 5E learning cycle model supported by concept cartoons for teaching problem-solving steps and strategies affect the attitudes of primary pre-service teachers towards mathematics teaching?

5. What are the opinions of primary pre-service teachers about the implementation?

Method

Research Model

One of the mixed method studies, the nested design, was used in the study as its model. Nested design is a strategy that combines quantitative and qualitative designs. A qualitative phase can be introduced to the experimental studies within the quantitative research in studies employing the nested design, and vice versa for the case study within the qualitative studies (Creswell, Shope, Plano-Clark, & Green, 2006). The principal objectives of this study encompassed the assessment of the problem-posing proficiency exhibited by primary pre-service teachers, an evaluation of the content, organizational structure, vocabulary, and language utilization within the texts comprising concept cartoons and problems crafted by these pre-service teachers, and an exploration of the impact of pedagogical practices related to lesson plan development predicated on the 5E learning cycle model, reinforced by the integration of concept cartoons, on the attitudes of these educators toward the instruction of mathematics. The quantitative portion of the study utilized a pretest-posttest one-group quasi-experimental design in this situation. The case study is employed in the qualitative portion of the study when there are several data sources and supporting evidence, and the underlying causes of some events are real-world factors (Yıldırım & Şimşek, 2018). The pre-service teachers' thoughts on the application were solicited through a semi-structured interview form.

Study Group

The study's objectives involved 38 primary pre-service teachers (20 female, 18 male) who were enrolled in the faculty of education at a medium-sized state university in the west of Turkey. One of the purposive sampling techniques, the criterion sampling approach, served as the foundation. In the criterion sampling approach, the researchers may opt for a predetermined set of criteria or alternatively, they may select and scrutinize instances aligning with criteria formulated by the researchers themselves (Yıldırım & Şimşek, 2018). In the context of the present research, the criteria for the chosen study group were delineated as follows: individuals classified as senior-level students majoring in primary education, those who have successfully completed the Mathematics Teaching I course, and individuals who have undertaken the Turkish Teaching course.

Data Collection Tools

The problem-solving scale created by the researchers, the interview form, the lesson plans created by the primary pre-service teachers, and the attitude scale toward mathematics teaching created by Göloğlu-Demir and Çetin (2012) were used as data collection tools within the context of the research problems. For the evaluation of problem-solving

proficiencies among primary pre-service teachers, an open-ended "problem-solving scale" was meticulously constructed. Prior to its formulation, an extensive review of pertinent literature was undertaken to inform the development of this scale, comprising 11 tasks designed to appraise the application of nine distinct problem-solving techniques. Following the problem-solving phases (understanding the problem, selecting a strategy, using the selected strategy, and evaluating the outcome), pre-service teachers were asked to respond to the scale's questions. 23 challenges were found in the first stage that attempted to employ the identified tactics, including generating a systematic list, using related small problems, working backward, creating a table, creating a diagram, and eliminating possibilities. Following the presentation of these challenges to two subject-matter experts, 12 problems that shared a common method were eliminated, 11 problems were chosen, and the scale was created. Outside of the study group, the scale was administered to three potential classroom teachers. It was found that there were no comprehensibility issues, so the scale was then finished. After the application, primary pre-service teachers were given the 11 questions from the scale. The pre-service teachers also chose one of the problems on the problem-solving scale, and they were tasked with creating concept cartoon-supported 5E lesson plans for introducing the technique to be applied to the chosen problem. The success rates of text construction for similar problems created within the parameters of the acquired concept cartoons and lesson plans were assessed. To ascertain the attitudes of potential primary pre-service teachers toward teaching mathematics, the "Attitude Scale towards Mathematics Teaching" created by Göloğlu-Demir and Çetin (2012) was utilized. A Likert-type scale with 25 items makes up the scale. As a result of the factor analysis performed to determine the construct validity, it was seen that the factor loads of the scale items ranged between 0.46 and 0.77, the Kaiser-Meyer Olkin (KMO) value was .90, and the internal consistency coefficient (Cronbach alpha) value calculated for the reliability study was $\alpha = .92$. To get perspectives on the practices, a semi-structured interview form was created. An item pool was developed for this purpose after a literature assessment. A panel of two field education experts were subjected to a series of 20 open-ended inquiries. Subsequent to obtaining expert input with regard to the items' efficacy in gauging the targeted construct, as well as their lucidity and overall comprehensibility, a portion of the items were deemed unsuitable and, as such, excluded. The resulting pre-test form, encompassing a total of 13 elements, was then finalized. To ascertain the applicability, duration, and understandability of the scale, the pre-test form was administered to four pre-service teachers who were not a part of the study group. The scale was completed once it was determined to be understandable.

Data Collection Process

Based on the primary school mathematics curriculum, problem-solving strategies were identified within the research's purview, and a teaching procedure was designed for the development of these strategies. Pre-service instructors were given a variety of issues to solve using these tactics, and concept cartoons that were modified to fit the 5E learning cycle were used to teach problem-solving phases and strategies. A five-stage method that spanned eight weekly class hours was used to achieve the research's goal. Figure 1 displays the research-related procedure steps.

Figure 1.

Research Process Steps

1	Within the scope of the undergraduate program Mathematics Teaching course, training was given on problem-solving steps and strategies, and reminders were made about their previous learning on the subject. In the three-week course hours, problem-solving steps; understanding the problem, choosing a strategy/plan, implementing the strategy/plan, checking the accuracy and validity of the solution, and constructing a similar/unique problem were observed and lectured with examples. For the contents to be designed to improve the problem-solving skills of primary school students, pre-service teachers were first informed that strategies such as making systematic lists, making use of similar simple problems, working backward, making tables, drawing diagrams, and elimination could be used, they were examined within the framework of "problem-solving steps" and in-class discussions were held.
2	During the one-week lesson process, four basic language skills (reading-listening-speaking-writing), which are used effectively in expressing feelings and thoughts, opinions, concepts, and facts verbally and in writing, were emphasized both in problem posing and in designing concept cartoons. Writing rules were mentioned and the issue of correct, economical, conscious, and attentive use of the mother tongue was included. While expressing their opinions and thoughts in writing in the writing process, it is emphasized that they should adopt a form of written expression that is effective, clear, and understandable, that will support the person who reads the problem sentence to understand and approach the question from a critical point of view, and that takes into account the rules of spelling and punctuation and expression disorder.
3	During the two-week course, concept cartoons based on the constructivist learning approach were introduced to pre-service teachers and it was mentioned that it is a strategy that supports students to establish a relationship with their previous learning. The aims of concept cartoons, how they should be designed, the digital tools they can use in this process, the purpose of use in the educational process, and their benefits, and limitations were mentioned.
4	During the one-week course, the 5E learning cycle model and reminders about the course design process were discussed, and it was mentioned that it is an effective model both in learning a new concept and in understanding a known concept in depth. The important contributions of the 5E learning model to student attitudes towards the course were given, the five stages of the model were introduced, and how to plan an educational situation design based on this model was explained to pre-service teachers with sample plans.
5	A study covering two weeks of class hours was carried out in order to raise awareness of pre-service teachers by brainstorming on how problem solving steps enriched with concept cartoons can be integrated into the 5E learning cycle model. Sample applications and lesson plan design were carried out for this purpose. Lesson plans with different contents prepared by the researchers were presented, discussed and the pre-service teachers were asked to evaluate the concept cartoons they created within the framework of problem solving process and 5E learning cycle model. The pre-service teachers were also expected to include speech bubbles containing different opinions or problem solving strategies that could create discussion and brainstorming in the cartoons they created in accordance with the 5E learning cycle stages.

Example of a Plan Integrating the 5E Learning Cycle

The research team created the following sample plan stages and explanations based on the concept of a cartoon-assisted 5E learning cycle model for teaching problem-solving processes and methods.

Figure 2.

Example of a concept cartoon supported 5E lesson plan

A group of journalists on a safari trip in Africa get lost in dense forestland. They are taken captive by a tribe living in the region. The journalists that are taken to the chief of the tribe are given a choice for their lives. Accordingly the chief says: "Take these prisoners to the temple and set them free in case they discover the number of the golden squares." When the journalists arrived at the temple, they see an area consisting of tiles in the form of squares. Only remedy for their survivals is to find out how many squares in total there are in this area.

Mr. A: There are 8x8=64 squares.

Mr. B: There are squares more than 64 but fewer than 11.

Mr. C: There are squares much more than 54 but we cannot find it with only the operation of multiplication.

How many squares are there, in your opinion? Do you agree with the journalists? Why or why not?

Mr. A: If we draw the square area of 8x8 and count one by one we obtain the result. For example we find the number of the squares, whose side is 1 unit. Later on we find the number of the squares, whose side is 2 units.

Mr. B: If we draw and count, we find it is hard to find. Let's make a list. The number of squares of 1x1=... The number of squares of 2 x 2=... The number of squares of 3 x 3=....

Mr. C: To me, if we draw square areas with smaller dimensions and find and list how many squares they contain, then we can establish a relation, so we can obtain the number of squares in the square area of 8x8 in a shorter way.

Express this strategy you learnt while solving the problem in your own words.

Create a problem so that you may use this strategy.

The answers given by the students to the questions are presented by the groups within the class and the conformity of the definition of strategy with the constructed problems is discussed and the feedback is given to the students. After discussing with the teacher on the correct form, they can realize their missing concepts. At the same time, students will reach a conclusion about the topic by assessing new knowledge and skills in this phase.

Enter/Engage: In this phase an attempt is made to reveal the students' preliminary information regarding the subject to be learnt and to draw their attentions to the new subject. Questions are asked to students to present their original ideas or solution suggestions regarding the given situation or the problem. The aim here is not to find the correct solution but to create an environment for brainstorming where the past knowledge as the first phase of learning is introduced. In the phase of Enter the role of the teacher is to expose the situation and correlate this situation with teaching. Accordingly, the teacher assumes the function of guidance in discovering the concept to be taught by asking correct and leading questions. Before handing out the instrument, students are divided into groups of 3-4 students. First, the test containing a non-routine problem prepared with the aim of having the students discern (comprehend) the strategy of "utilizing from solutions of similar simple problems" as one of the problem solving strategies is presented to the students. After reading the non- routine problem passage two questions related with this story the questions of "How many squares are there, in your opinion?" "What are the journalists' estimations?" may be asked to the questions. Students discuss the answers of these questions in groups and they are requested to write them in the balloons of the sheet of paper give to them. Later on, the concept cartoon, in which there are the estimations of journalists regarding problem solving, is presented to the students. Students are asked about whether they agree with the journalists and the reasons why they think that way. Students are made to discover squares that are much more than 64 squares through discussion and various guided discovery questions.

Explore: This phase is the one where the students are the most active. The aim is to evaluate the produced ideas with the teacher and then to transform them into skills and the ways of solution in order to analyze the situation. Teacher is the leader. Students are encouraged to find ways of solutions in this phase where direct teaching is not performed. Students are made to become aware that they cannot solve the non-routine problem depending on their knowledge on solving the problems with arithmetical operations and four operations. From this point of view, they are encouraged to discover new problem solving strategies by combining their previous learning and the new problem situation. In this phase students are requested to discuss in groups about what is the way to follow for the calculation of square number for the students that have decided on the correctness of the third journalist in figure 3 in the previous cartoon.

Explain: This phase is the one where the teacher is the most effective. The teacher creates opportunities for the students to disclose their own findings to others. In the phase of Explore groups explain their strategies they developed for the solving of the problem. After that, where possible, the teacher makes explanations at the level of basic knowledge to the students to combine their experiences, disclose their results, and form new concepts (Bybee, 1997). After this process the concept cartoon containing the solution strategies developed by the journalists is presented to the students in order to discover the square number. In concept cartoon there are the answers given by the journalists. The teacher wants the students to make an evaluation between the strategies presented by them and the journalists' solution strategies. The teacher starting from the third journalist's explanation, which is the most proper way of solution, makes the students discover the numeric pattern between the numbers of square. After that, he explains that this strategy used is the strategy of "utilizing from solutions of similar simple problems" as one of the problem solving strategies. The teacher states that this strategy is different from those used in problems with four operations and that it provides convenience in solving non-routine problems.

Elaborate: In this phase the students apply the knowledge they obtained together or the problem solving approach to new situations and problems. In this way they organize new concepts that have not existed in their minds before. A new problem situation is presented to ensure that the students rethink about the correctness of the concepts they have learnt and to make the concepts more understandable. At this point, the teacher expects the students to assume responsibility to apply the new knowledge to the concerned problem (Campbell, 2000). Accordingly, in order to create a new experience the following problem is given to the students to use the strategy of "utilizing from solutions of similar simple problems"

Evaluate: In this phase formative and summative evaluations are performed regarding the students' learning. The teacher evaluates the knowledge and skills the students acquire. Although this evaluation is performed at each phase, the aim of the evaluation performed in the phase of evaluate is to check (examine) whether or not the student understands fully the knowledge or the concept given. Assessment and evaluation could be in the form of the teacher evaluating the students and it also contains students' evaluations regarding themselves and the effectiveness of their educational statuses. Accordingly, the following questions are asked to the students in order to complete the model

Small cubes: Sucan has a large cube consisting of 64 small cubes. All its external surfaces are painted. Thus, three surfaces of some of the small cubes are painted, two surfaces of some of them are painted, and one surface of some of them is painted. None of the surfaces of some of them are painted. How many cubes of Sucan with three surfaces are painted? How many cubes of Sucan with two surfaces are painted? And how many cubes of Sucan with one surface are painted? How many of them with none of the surfaces are painted?

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Data Analysis

The problem-solving skills of primary pre-service teachers were evaluated within the scope of the problem-solving scale applied after the lesson plan development practices based on the 5E learning cycle model supported by concept cartoons for teaching problem-solving steps and strategies. Subsequent to the implementation, the pre-service teachers responded to the items within the scale by adhering to a structured sequence of problem-solving stages, which encompassed the phases of problem comprehension, strategy selection, strategy implementation, and solution evaluation. To evaluate the problem-solving skills of pre-service teachers, the answers given to the problem-solving scale were examined and evaluated with the progressive scoring scale used in the problem-solving process created by Baki (2008). The progressive scoring scale consists of five categories (understanding the problem, preparing a plan, implementing the plan, evaluating, and posing a problem) and defines the highest and lowest performance of each criterion as 0, 1, 2, and 3 points. A maximum score of 3 and a minimum score of 0 is obtained from each step of problem-solving. The data obtained were presented and interpreted with frequency and percentage values using descriptive analysis techniques.

In addition, pre-service teachers were asked to select one of the problems they solved and develop a concept cartoon-supported 5E lesson plan by considering the problem-solving steps in which the strategies they used in the solution were aimed to be taught. The pre-service teachers were tasked with the formulation and explication of their pedagogical lesson plans, whereby they were required to buttress their instructional solutions, which inherently comprised four distinct stages. These stages included the presentation of a concept cartoon corresponding to the phase of comprehending the problem, a concept cartoon associated with the strategy selection phase, a concept cartoon featuring annotations signifying the application of the chosen strategy, and a concept cartoon dedicated to the critical evaluation of the obtained solution. The problems constructed by the pre-service teachers in the evaluation step were analyzed in terms of their problem-posing skills. The rubric for evaluating problem statement skills developed by Özgen, Aydın, Geçici and Bayram (2017) was used to analyze the problems. The criteria for evaluating problem-posing skills in the rubric include the criteria of using mathematical language (symbol, notation), grammar and expression appropriateness, the appropriateness of the problem to the learning outcomes, the amount and quality of data in the problem, the solvability of the problem, the originality of the problem, and the solvability of the problem by the student. The minimum score for each criterion is 0, and the maximum score is 3. The level range is scored as Level 1 for values between 0.00 and 0.75, Level 2 for values between 0.76 and 1.50, Level 3 for values between 1.51 and 2.25, and Level 4 for values between 2.26 and 3.00 (Güner, 2021). Level contents are defined as the level at which the problem provides mathematical problem properties. Two field education experts examined the problems. Inter-coder reliability was found to be approximately 80%.

The texts in the problems constructed with concept cartoons prepared by primary pre-service teachers were scored using the "Analytical Grading Scale" developed by Weigle (2002) and adapted into Turkish by Ülper (2019). The rubric has five sub-dimensions: "content, organization, vocabulary, language use, and mechanics." These sub-dimensions were scored at four levels (very good, good, fair, poor): 30-22 (very good), 26-22 (good), 21-17 (fair), 16-13 (poor) for the first sub-dimension "content"; 20-18 (very good), 17-14 (good), 13-10 (fair), 9-7 (poor) for the

second sub-dimension "organization"; 20-18 (very good), 17-14 (good), 13-11 (medium), 9-7 (bad) for the third sub-dimension "word use"; 25-22 (very good), 21-18 (good), 17-11 (medium), 10-5 (bad) for the fourth sub-dimension "language use"; and 5 (very good), 4 (good), 3 (medium), 2 (bad) for the fifth sub-dimension "mechanics". The evaluations were made by two Turkish education experts and one mathematics education expert, and the agreement between the raters was 85%.

The attitude toward mathematics teaching scale data obtained before and after the applications in the study was evaluated using t-tests for unrelated samples. The opinions of the pre-service teachers regarding the application were obtained through a semi-structured interview form, and the content analysis method was used for data analysis. The primary objective of content analysis resides in the systematic organization and interpretation of data sharing analogous characteristics, encapsulated within the context of overarching concepts and thematic constructs, as expounded by Yıldırım and Şimşek (2018). To analyze the data obtained from the interview form, the interviews with the pre-service teachers were recorded, and then the opinions were coded. After coding and organizing the themes, the opinions of two field experts were taken. The code agreement between the two experts was determined as 89%, and a consensus was reached on the issues where there were differences.

Findings

Within the framework of the first problem of the study, the responses of the pre-service teachers to the problem-solving scale were evaluated with the progressive scoring scale (Baki, 2008) used in the problem-solving process. The distribution of the strategies used by the pre-service teachers in solving the problems is presented in Graph 1.

Graph 1.

Distribution of The Strategies Used by Pre-Service Teachers
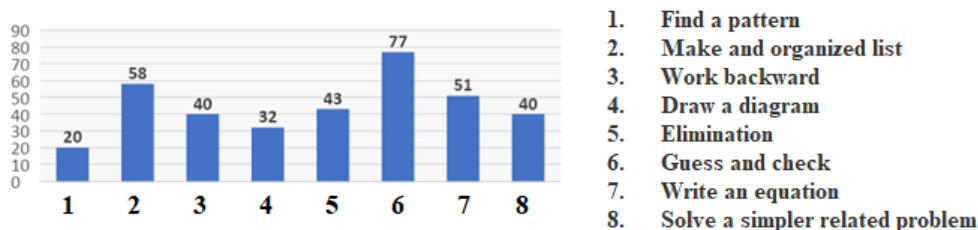
1.	Find a pattern
2.	Make and organized list
3.	Work backward
4.	Draw a diagram
5.	Elimination
6.	Guess and check
7.	Write an equation
8.	Solve a simpler related problem

For the problems in the problem-solving scale, some students presented solutions using more than one strategy. When Graph 1 was analyzed, it was seen that 6% of the strategies used by the pre-service teachers were image finding, 16% were systematic list making, 11% were working backward and using similar and simple problems, 9% were drawing shapes and diagrams, 12% were elimination, 21% were prediction control, and 14% were equation construction strategies. Certain strategies employed by the primary pre-service teachers were omitted from consideration due to their lack of accuracy and alignment with the intended criteria. It was seen that the most commonly used strategies were the prediction control strategy and equation construction strategy. Some of the pre-service teachers did not make solutions to the strategy they specified. For example, although they stated that they chose the estimation control strategy, they solved the problem by setting up an equation. The problem-solving skills

of the pre-service teachers were evaluated by examining their problem solutions for the problem-solving steps. Mean scores were calculated for the data obtained from the rubric used. The answers of the pre-service teachers to the questions in the problem-solving scale were evaluated according to the rubric. The results obtained are presented in Table 1.

Table 1.

Problem-Solving Scale Progressive Scoring Key Results

	Components				
	Understanding the Problem ($\bar{X}$)	**Making the Plan ($\bar{X}$)**	**Implementing the Plan ($\bar{X}$)**	**Evaluation ($\bar{X}$)**	**Problem Statement ($\bar{X}$)**
Question 1	2.89	2.81	2.52	2.42	1.76
Question 2	2.89	2.79	2.52	2.36	1.60
Question 3	2.89	2.81	2.52	2.42	1.76
Question 4	2.89	2.81	2.53	2.42	1.77
Question 5	2.81	2.73	2.47	2.42	1.92
Question 6	2.86	2.73	2.42	2.42	1.97
Question 7	2.84	2.73	2.44	2.42	1.92
Question 8	2.84	2.76	2.43	2.34	1.97
Question 9	2.78	2.71	2.42	2.36	1.76
Question 10	2.89	2.78	2.44	2.36	1.94
Question 11	2.89	2.81	2.52	2.42	1.30
Total	2.86	2.77	2.47	2.39	1.78

When Table 1 is examined, among the 11 questions in the "understanding the problem" and "understanding a part of the problem" categories in the "understanding the problem" step, pre-service teachers scored an average of 2.86 points, among the questions in the "preparing a plan" step in the categories of "choosing a strategy that will lead to an appropriate solution", "choosing only a part of the strategy that will help the solution" and "choosing an inappropriate strategy", pre-service teachers scored an average of 2. 77 points, an average of 2.47 points was obtained from the categories of "reaching an appropriate and correct solution", "making a partially correct solution", "making an appropriate and incorrect solution" in the "implementing the plan" step, and an average of 2.42 points was obtained from the categories of "solving the problem and the new problem created according to this problem", "logical verification of the results", "partial verification of the results", "not knowing how the results will be correct" in the "evaluation" step. When analyzed in terms of problem posing, it was determined that the average score of the primary pre-service teachers was 1.78. In general, when the problem-solving skills of the primary pre-service teachers who participated in the application were examined, it was seen that they were successful in the steps of understanding the problem, preparing a plan, and implementing the plan, but some students had difficulty in using the strategies they determined as appropriate strategies, especially in the step of making a plan and preparing the plan. For example, in "making a table" or "estimation control" strategies, it was determined that they solved the problems based on the strategy of forming and solving equations different from the strategies specified by the students or that they characterized a solution with an estimation control strategy as a systematic list and misnamed it. In addition, it was observed that the average scores of the pre-service teachers were low mostly in setting up a simple similar problem and evaluating the accuracy and validity of the solution.

Secondly, the primary pre-service teachers were instructed to choose one of the problem scenarios addressed in the problem-solving scale and construct a 5E lesson plan supplemented by a concept cartoon, intended to facilitate the instruction of the problem-solving strategies they had employed during the solution process, while taking into account the sequential problem-solving phases. The problems framed by the primary pre-service teachers within the concept cartoons, which were created through a consideration of the problem-solving steps, underwent a comprehensive analysis focusing on the proficiency of the problem statement skills. A rubric (Özgen et al., 2017) was used to evaluate problem posing skills. When the results obtained were analyzed, it was seen that the pre-service teachers constructed 32 problems, and 6 pre-service teachers did not construct any problems. When the constructed problems were examined, it was seen that the average score for the criterion of using mathematical language (symbol, notation) was 1.12, i.e., level 2; the average score for the criterion of grammar and expression appropriateness was 1.75, i.e., level 3; the average score for the criterion of the appropriateness of the constructed problem to the gains / selected strategy was 1.87, i.e., level 3; the average score for the amount of data and expressions in the problem and logical, procedural appropriateness for solving the problem was 2. 06, i.e., level 3; the average score for the criteria of the solvability of the problem, i.e., the solvability of the problem, was 2, i.e., level 2; the average score for the criteria of the originality of the problem in terms of the textual organization and the steps to reach the solution was 1.62, i.e. level 2; and the average score for the criteria of the solvability of the problem by the student was 0.25, i.e. level 1. The problem suggested by PT21 to be solved with the prediction control strategy is as follows.

Uncle Yusuf wants to plant trees on his newly bought land. Every year, Uncle Yusuf reforests his farm 3 times more than the first year he planted trees. After 5 years, Uncle Yusuf has 2430 trees. How many trees did Uncle Yusuf plant in the first year?

When the problem presented is examined, it is seen that the expressions given to solve the problem are incorrect and unsolvable. He used mathematical language incorrectly. Similarly, the problem text that T11 suggested to be solved with the guessing control strategy is as follows.

There are 21 questions in an exam with over 100 points. Some of these questions are worth 4 points, and some are worth 6 points. How many 6-point questions did a student who answered all the questions and got 60 on this exam do?

The data provided within the problem context reveals an incongruity between the information proffered for the problem's solution and the assertion that a solution is unattainable. The problem in question, which was recommended for resolution through the implementation of the diagramming strategy by PT8, is articulated as follows. *Mr. Arif will plant vegetables again after leaving his 100-meter by 100-meter field fallow for a year. But he could not decide how many kinds of vegetables to plant. For this reason, he decides to divide his field with different colored fences that he likes and plant one kind of vegetable in each section. How many kinds of vegetables can Mr. Arif plant in his field by dividing it with blue, pink, and yellow colored hedges of 30 m by 20 m in length?*

The mathematical language used in the problem is incorrect, as in the expression "100 meters by 100 meters field". Geometric features are left incomplete. There are inappropriate data and incomplete expressions in the

problem text. In this case, it is not solvable due to the uncertainty of the shape of the field and the lengths given. According to the results obtained, it was seen that the pre-service teachers were not sufficient in terms of problem-posing criteria, and only eight pre-service teachers solved the problems they posed. It was observed that many pre-service teachers constructed new problems by unconsciously changing the numerical value of the questions in the problem selected in the problem-solving test, thus producing unsolvable problems. In addition, it was seen that there were various expression disorders or spelling mistakes in the problem texts, which should be paid attention to the use of mathematical language and the conformity of the question text to the grammar rules. Within the scope of the third sub-problem of the study, the texts and problem statements in the concept cartoons prepared by the pre-service teachers were scored with the "Analytical Grading Scale," which is a scoring key developed by Weigle (2002), the text formation levels of the pre-service teachers were determined, and the results were analyzed with percentages and frequencies. The results obtained are presented in Table 2 and Table 3.

Table 2.

Findings Related to the Analytic Grading Scale of Concept Cartoons

	Very good		Good		Moderate		Bad	
	f	%	f	%	f	%	f	%
Content	-	-	31	81.57	7	18.42	-	-
Regulation	25	65.78	13	46.42	-	-	-	-
Word	20	52.63	16	42.19	2	5.27	-	-
Language Use	17	44.73	10	26.31	11	28.94	-	-
Mechanical	4	10.52	6	15.78	17	44.73	11	28.94

When Table 2 is examined, there were no texts characterized as very good or bad in terms of content in the concept cartoon texts prepared by primary pre-service teachers. 81.57% of the texts were found to be good, and 18.47% were found to be at a moderate level. This implies that the extent of knowledge possessed by primary pre-service teachers concerning the subject matter or the strategy employed within the written expression process is characterized by a moderate level of proficiency. Moreover, the information conveyed to the reader pertaining to the subject matter is noted to be somewhat lacking in comprehensibility, often resulting in an incomplete dissemination of the requisite information, thereby precluding a satisfactory degree of developmental depth. In terms of organization, it was found that none of the concept cartoons were included in the moderate or bad subcategory; 65.78% were described as very good, and 46.42% were described as good. This means that the narration in the concept cartoons prepared by the pre-service teachers progressed at a fluent and logical level, the sentences were well organized, and the principle of coherence was met. Simultaneously, the utilization of concept cartoons is noted for its ability to convey intended ideas with a commendable degree of clarity and organization, albeit occasionally characterized by a degree of disconnection between ideas and, on certain occasions, limitations in the scope of the desired thoughts. When evaluated in terms of word usage, 52.63% of the texts in concept cartoons are at a very good level; that is, it is seen that primary pre-service teachers prefer rich, original, and effective words or phrases in text

construction and there is no problem in this usage. It was seen that 42.19% of them created texts at a good level, the vocabulary used was at a sufficient level, although not very rich, and sometimes there were mistakes in the use of selected words or phrases. In the remaining 5.27% of the texts, the level of the texts was limited to moderate, and there were frequent errors in the selection and use of words or phrases. No text was found to be at a poor level. When the concept cartoons prepared by pre-service teachers were analyzed in terms of language use, it was seen that 44.73% of them were at a very good level. In the texts prepared at this level, there are very few expression disorders, and original and advanced sentence construction is observed. Among the texts, 26.31% of the texts with simple but partially original sentence structure and rare expression disorders were found to be at a good level with 26.31%. The remaining 28.94% of the texts were at a moderate level, where significant problems were observed even in simple sentence constructions, and expression disorders were observed in written expressions. No text was found to be at a poor level. When the prepared concept cartoons are analyzed mechanically, it is seen that 44.73% of the texts are at a moderate level. This situation shows that pre-service teachers frequently make mistakes in spelling, punctuation, and paragraphing while creating written texts. Their writing is bad, and there is uncertainty in inferring meaning. While 15.78% of the texts were found to be at a good level, 10.52% were found to be at a very good level. Two examples of the linguistic problems encountered in concept cartoons designed by pre-service teachers is presented in Figure 3 and Figure 4.

Figure 3.

Example of a concept cartoon prepared by PT11

As it can be understood from the example given in Figure 3, the sentences formed by the pre-service teacher do not conform to Turkish syntax, and it is seen that there are mistakes in the use of spelling and punctuation marks and the use of conjunctions - mistakes in the spelling of the conjunction de and the suffix -de. Therefore, it can be said that the criteria of expression disorder and clarity are also violated. As it is known, spelling rules aim to facilitate communication between the reader and the writer and to ensure integrity in writing. However, it is seen that this example expression makes comprehensibility difficult. Another example belongs to PT13, presented in Figure 4.

Figure 4.

Example of a concept cartoon prepared by PT13

> 7. yılda 3200 tavşan olduğuna göre 6. yılda yarısı 1600 tavşan vardır. Bu şekilde geriye doğru giderek ilk yılı buluruz.

> 3200 sayısını 14'e bölersek cevabı buluruz.

Buğra

Poyraz

When the concept cartoon in Figure 4 is examined, it is seen that in addition to word order, spelling, and punctuation errors, there are also errors in terms of word and phrase selection. The "backward strategy", which is used as a mathematical term, was identified as an error in the use of a missing word group.

Table 3.

Scores of Similar Constructed Problems on the Analytic Grading Scale

	Very good		Good		Moderate		Bad	
	f	%	f	%	f	%	f	%
Content	7	21.87	10	31.25	9	28.12	6	18.75
Regulation	32	100	-	-	-	-	-	-
Word	30	93.75	2	6.25	-	-	-	-
Language Use	30	93.75	2	6.25	-	-	-	-
Mechanical	29	90.62	3	9.37	-	-	-	-

When Table 3 is examined, it is seen that 31.25% of the similar problem texts created by the primary pre-service teachers are at a good level in terms of content. This indicates that a sufficient level of comprehensibility is provided in the texts; information about the subject is included, but the details provided are incomplete. Following these texts, it is seen that there are texts at moderate level (28.12%), very good level (21.87%), and bad level (18.75%). Upon analysis conducted with regard to organizational attributes, it is evident that the entirety of the texts, constituting 100% of the sample, consistently exhibit a high degree of organizational proficiency. In such instances, the predominant feature entails an unwavering fluency in expression, the articulation of thoughts in a methodical and logical manner, and the preservation of the fundamental principle of coherence. In terms of word usage, 93.75% of the texts are at a very good level, while 6.25% are at a good level. This situation shows that the words and word groups used in the texts were chosen correctly, an original usage was adopted, and there were no problems in word usage. In terms of language use, it was observed that most of the texts (93.75%) were at a very good level, there were

not many expression disorders, and originality and sophistication were dominant in sentence construction. It is seen that 6.25% of the texts are at a moderate level. This situation shows that pre-service teachers created texts that contain expression disorders. In terms of mechanics, 90.62% of the texts were at a very good level, showing that there were almost no errors in spelling, punctuation, and paragraphing. The remaining 9.32% of the texts were found to be at a good level.

Regarding the fourth sub-problem of the study, the data obtained to examine the effect of the teaching practices on the attitudes of primary pre-service teachers towards mathematics teaching were examined in terms of normality. Table 4 presents the normality test results.

Table 4.

Shapiro-Wilk Test Normality Results of Pre-Post Attitude Scores

	Shapiro-Wilk Value	**Skewness**	**Kurtosis**
Pre-attitude	.20	.094	.83
Post-attitude	.10	-26.	-.88

According to George and Mallery (2010), if the kurtosis and skewness values are between -2.0 and +2.0, it is assumed that the data are normally distributed. Consequently, upon meticulous scrutiny of the data in Table 4, it becomes evident that the data acquired from the attitude scales, both prior to and following the intervention, adhered to a normal distribution pattern ($p > .05$). In light of this observed normal distribution, the disparities between the pre- and post-attitude scores were subjected to comparison through the utilization of a t-test for related samples, with the resultant findings duly presented in Table 5.

Table 5.

t-test Results Regarding The Pre-Post Attitude Towards Mathematics Teaching Scores of Primary Pre-Service Teachers

	N	**$\bar{X}$**	**Ss**	**t**	**sd**	**p**
Pre-attitude	38	3.70	.30	-3.94	37	.00*
Post-attitude	38	4.01	.34			

When Table 5 was examined, it was determined that the mean pre-test attitude score of pre-service teachers towards mathematics teaching was 3.70, and the mean post-test attitude score was 4.01. When the difference between pre-test and post-test mean scores was analyzed by applying a t-test for related samples, a statistically significant difference was found ($p>.05$). This result was interpreted as the teaching practices made a significant difference in favor of the post-test in increasing students' attitudes towards mathematics teaching.

When the opinions of pre-service classroom teachers regarding the fifth sub-problem of the research were examined, it was seen that the opinions on the use of concept cartoons in the education process were gathered in six categories. These were discussed in terms of advantages, disadvantages, purposes of use in the teaching process, problem-solving, emotions and feelings, and language use. The six categories and codes related to the sub-problem in question are shown in Figure 5.

Figure 5.

Categories and Codes for Concept Cartoons and Their Use In Teaching

In terms of feelings and emotions
- fun
- engaging
- motivator
- intriguing

Purposes of use in teaching process
- to draw attention
- to reveal misconceptions
- to enable the discovery of knowledge
- to be a teaching aid
- to develop questioning skills
- to develop problem skills
- to teach different ways of solution
- to motivate you for the lesson
- to create an atmosphere for discussion
- to make an assessment
- to reinforce what has been learnt
- to create brainstorming
- to reach every student in the class
- to reinforce
- to ensure active learning

Concept Cartoons

Problem Solving

Positive
- develop problem solving skills
- present alternative solution strategies
- adapting the problem to everyday life
- to see different perspectives on the solution of the problem
- manage the problem solving process
- to ensure the use of problem solving steps
- to provide an opportunity for discussion for the step of understanding the problem
- to put forward different ways of solution
- ensure the evaluation of selected strategies
- to provide an opportunity for the process of evaluating the solution to take place

Negative
- Having difficulty in writing different solutions to problems
- Difficulties in adapting the cartoons to the problem-solving process
- Having difficulty in writing problems appropriate to the student's level
- Some of the problem solutions do not fit in the bubbles
- Problems in expressing the problem solution by thinking like a student
- Problems in creating the problem-solving steps of the prepared problem
- Having problems in problem-solving by using different strategies

Disadvantages
- Taking a long time to prepare the material
- The problem of wages in the preparation of digital materials
- Not knowing how to use Web 2.0 tools
- Lack of Turkish language support for cartoon programs
- Inaccessibility of digital material creation tools
- Not every problem can be visualised
- Noise in the classroom
- Course time may be insufficient for the use of materials
- Possibility of creating misconceptions
- Limited use of cartoons due to lack of prior knowledge of students
- Difficulty in creating pictures and speech bubbles

Advantages
- Increasing memorability
- Facilitating clarity
- Developing different thinking-different perspective
- Facilitating learning
- Prompting reflection
- Making the students active
- Ensuring that different views are recognized
- Supporting visual intelligence
- Increasing persistence
- Ensuring respect for different views

In terms of language use
- Understandability
- Consistency
- Expressiveness
- Compliance with Turkish syntax
- Suitability to student-level
- Expression disorder
- Word choice and usage

In Figure 5, according to the evaluations of pre-service teachers, in the category of "advantages," opinions were obtained under the codes of "increasing retention, facilitating comprehension, developing different thinking or different perspectives, facilitating learning, encouraging students to think, making students active, enabling different opinions to be noticed, supporting visual intelligence, increasing retention, ensuring respect for different opinions" and sample opinions are presented below.

PT5: Concept cartoons increase the retention of the subject and make it easier to understand. It helps to develop different ways of thinking.

PT8: Concept cartoons develop different perspectives on an event or problem.

PT9: It makes the lesson fun. ... being visual and interesting makes learning easier. It supports visual intelligence.

In the second category, "disadvantages", "the preparation of the material takes a long time, there is a fee problem in the preparation of digital materials, not knowing how to use Web 2. 0 tools, lack of Turkish adaptation (language support) of cartoon programs, inaccessibility of digital material creation tools, inaccessibility of digital material creation tools, inability to visualize every subject, noise environment in the classroom, insufficient class time for the use of materials, the possibility of creating misconceptions, limited use of concept cartoons in students' lack of prior knowledge, difficulty in creating pictures and speech bubbles", and sample opinions are given below.

PT4: It causes confusion and noise in the classroom. ... It can be tiring for teachers in terms of preparation.

PT12: The only disadvantage is that the preparation process is laborious and time-consuming.

PT14: It is a time-consuming preparation process, and the use of Web 2.0 tools should be well known.

In the third category, "purposes of use in the teaching process", opinions were reached under the codes of "attracting attention, revealing misconceptions, eliminating misconceptions, enabling the discovery of knowledge, using it as an auxiliary tool for teaching, developing questioning skills, developing problem-solving skills, teaching different ways of solution, motivating towards the lesson, creating a discussion environment, making an evaluation, reinforcing what is learned, creating brainstorming, reaching every student in the class, reinforcing, providing active learning" and sample opinions are presented below.

PT24: I can make my lesson more interesting and attention-grabbing with cartoons instead of lecturing with lectures.

PT12: I use them to reinforce the lesson better and to make learning more effective and fun. I use it to make students' mind levels and thought structures more different. It saves me time. It allows me to easily identify where students have learned and where they have not learned. This facilitates me in terms of feedback and elimination of deficiencies. I use it because I support a student-centered education.

PT8: Since students are active with concept cartoons, meaningful learning is more, and permanent learning is provided.

PT20: For the teacher, the information before starting a new subject can be tested. The teacher can use it for evaluation at the end of the subject. The teacher can involve children in the discussion and let them brainstorm. For the student, reinforcement of a newly learned subject is ensured. Children reach the information themselves as a result of learning by thinking.

In the fourth category, "feelings and emotions" category, opinions were reached under the codes "fun, interesting, motivating, intriguing", and examples of the opinions are presented below.

PT20: Since cartoons are given visually, cartoons make learning easy and fun.

PT32: Students have fun in the process, and their motivation to learn increases.

The fifth category, "problem-solving", was analyzed in two subcategories under the titles of "positive" and "negative". Accordingly, in the "positive" subcategory; "developing problem solving skills, presenting alternative solution strategies, adapting the problem to daily life, seeing different perspectives on the solution of the problem, managing the problem solving process, ensuring the use of problem solving steps, providing discussion opportunities for the step of understanding the problem, revealing different solution ways, providing the evaluation of the selected strategy, providing an opportunity for the development of the process of evaluating the solution"; In the "negative" subcategory, opinions were found under the codes "having difficulty in writing different solutions to problems, having difficulty in adapting cartoons to the problem solving process, having difficulty in writing problems appropriate to the student level, some of the problem solutions not fitting into the bubbles, having problems in

expressing the problem solution by thinking like a student, having problems in creating the problem solving steps of the prepared problem, having problems in solving problems using different strategies". Examples of the opinions are presented below.

PT11: Cartoons show children both the right way and the wrong solution in the problem-solving process. It shows that the problem can be solved in another way.

PT12: Before starting to use concepts cartoons, a good scenario about the problem should be created. Cartoons should be designed in a way to evoke the problem in the other party.

PT15: We need to integrate the steps of problem-solving into the cartoons. Thus, the child tries to solve the problem in the cartoon, recognizes different ideas, and learns different strategies and problem-solving steps while solving the problem.

PT32: While preparing the concept cartoon, I had the question, "What would the students answer to this?". Because I had a problem expressing the problem solution by thinking like a student, I had difficulty in predicting where and how they would have misconceptions and what ways they would think. Other than that, I did not have any other problems.

Under the sixth category, "in terms of language use," the codes of "comprehensibility, consistency, expressiveness, syntactic appropriateness, level appropriateness, expression disorder, word choice, and usage" were found. Examples of opinions are presented below.

PT11: The language should be simple and understandable. Problems should be at a level of comprehensibility that students can discuss.

PT28: Written texts and visuals should be consistent with the subject.

PT22: Texts should be written according to the literacy level of each student.

PT2: Sentences should be proper and understandable. Attention should also be paid to the words used.

PT3: Attention should be paid to the use of abstract and concrete concepts.

According to the findings obtained, it was determined that prospective classroom teachers had positive opinions about the use of concept cartoons in the problem solving process. They think that the use of cartoons will be effective in the realization of problem solving steps. However, it is seen that they have difficulty in writing thinking bubbles in the process of pedagogical organization of cartoons. In this process, pre-service teachers are expected to give examples of faulty reasoning and solutions that can create discussion. It is thought that the reason why pre-service teachers have difficulty in this process is that they have little interaction with students in the real learning environment. It is thought that pre-service teachers who interact with students only during teaching practice will increase their knowledge of understanding students more during their real teaching experiences. Thus, it may be easier to create possible answers that students can give in cartoons. The pre-service teachers articulated that concept cartoons may be effectively integrated into the pedagogical process to achieve a spectrum of objectives, including capturing students' attention, fostering an environment conducive to discussion, motivating learners, consolidating

knowledge, and conducting assessments. Furthermore, they underscored the significance of certain elements such as comprehensibility, cohesiveness, clarity of expression, and lexical precision in the creation of concept cartoons, particularly with respect to linguistic utilization. Additionally, during the process of devising these visual aids, they discerned potential drawbacks associated with the utilization and accessibility of digital tools. In addition, they considered classroom management problems and new misconceptions that may arise during the implementation of concept cartoons as disadvantages.

Discussion, Conclusion and Recommendations

When the texts in the concept cartoons and issues created by primary pre-service teachers were assessed for text generation success levels, it was discovered that they were often at very good and good levels. In terms of percentages, it is clear that there are issues with text production's usage of language and substance. One may say that there are some knowledge gaps, particularly in terms of mathematics topic understanding, problem-solving skills, and problem presentation. Additionally, there are issues with advanced sentence formation and expressive disorder. Word sequences should be achieved by taking into consideration specific rules to transmit the thoughts to be expressed accurately, not only in written expression studies connected to daily life but also in writing studies related to the process of developing a mathematical problem. Syntactic analysis can be used to check for and correct errors in this area. According to research, mathematics lessons should include knowledge that is relevant to writing skill studies (McCarthy, 2008). People consider ideas carefully. The ability to communicate one's thoughts through language is crucial, and the easier and clearer one's ability to do so will depend on the depth of one's vocabulary.

According to the parameters of this study, it was discovered that the aspiring primary pre-service teachers were unable to very effectively and appropriately use the language in the written texts they produced during the concept cartoon and related problem-posing processes. Therefore, it is believed that studies on the creation of language-related content should be incorporated not only in research for the Turkish teaching course but also in research on teaching in other subjects. This can be reinforced, for instance, through the use of problems in the teaching of mathematics, oral history studies in the teaching of social studies, experimental setup in the teaching of science, or poster studies that can be created in the lives of scientists. Although few studies address problem statement studies with an interdisciplinary approach in terms of mathematics and linguistics (Arıkan & Ünal, 2013; Karakuş, Turhan-Türkkan, & Karakoç-Öztürk, 2020; Silver & Cai, 1996; Şengül-Akdemir & Türnüklü, 2017; Turhan & Türkkan, 2017), this is an indication that the sensitivity and importance given to the effective use of verbal language skills are not ignored. It is a complex and challenging procedure that necessitates high-level thinking to create a form of expression and a language result through written expression in mathematics (Karakuş et al., 2020). As a result, both students and pre-service teachers have trouble using their communication abilities when posing problems. To address the topic from many viewpoints, field specialists who are working on this issue can be provided because research suggests that reading and problem-solving abilities are closely related to the skills and success improvements that students need to ensure the effectiveness of the educational process (Balow, 1964; Call & Wiggins, 1966; Hollander, 1978; Muraski, 1979; Muth, 1988).

Making the constructivist method effective is crucial because the mathematics curriculum was developed within its parameters. Concept cartoons are one means of ensuring this efficacy. Concept cartoons are believed to enhance the constructivist learning process by making mathematics enjoyable, captivating, and engaging despite its abstract nature. According to research on concept cartoons, they aid pupils in developing affective behaviors and boost their motivation (Keogh & Naylor, 1999). Concept cartoons are viewed as a technique to cultivate good attitudes toward mathematics, according to the social constructivist theory that relates the cause of low mathematics self-efficacy to the attitude toward mathematics (Hackett & Betz, 1989). Dabell (2008) mentions that after students are shown a cartoon focusing on a conceptual obstacle, they are allowed to think independently about this problem situation/challenge, and small group discussion is encouraged. This is in reference to the use of concept cartoons that positively affect learning when used in many different disciplines in addition to the aforementioned positive effects. He stresses the value of providing chances for the entire class to provide input on competing theories, working toward a consensus, and giving students a chance to explore a variety of potential points of view to gain more knowledge. In this way, he argues that it is crucial to communicate the findings of the studies, giving students the chance to consolidate and apply what they have learned while also thinking about how their ideas may evolve. It is advised that concept cartoons be widely employed in basic and secondary educational institutions as well as higher education to make mathematics instruction understandable and remarkable because the usage of concept cartoons in the educational process is so effective. A one-group experimental design was implemented in the construction of this study. It is recommended that future research endeavors explore the utilization of pre-test-post-test control group experimental designs to enhance the depth of investigation or employ a combination of qualitative and quantitative research methods for a more comprehensive evaluation of the observed impacts. Mathematical problem solving skills and effective communication through language are two inseparable elements. Considering the relationship between problem solving skills and reading and reading comprehension skills, it is recommended that studies that support pre-service teachers' language and expression skills for writing skills as well as problem solving skills should be carried out. In this context, interdisciplinary instructional designs can be developed between the concepts of Turkish and Mathematics teaching and their impacts can be analyzed.

From the perspective of future classroom teachers, the concept cartoons diagnostic method has a very important role in professional preparation. Because it can shed light on the potential reasoning of prospective teachers that may emerge in the classroom during teaching practices. The concept cartoon method can link teachers' professional vision with knowledge-based, reasoning and noticing skills and reveal these skills in the process of observing teaching practices and supporting them with discussions. The use of educational concept cartoons as an assessment tool in a mathematics content course for future teachers will provide them with a broad knowledge of various aspects of knowledge that are more or less related to the mathematical content they will teach in their teaching practice. The use of concept cartoons in the educational process provides a detailed reflection of how pre-service teachers reason about the topic, how they understand the basic concepts, what mathematical language they use, what kind of arguments they can present, and how they react to alternative ideas. Assessing content knowledge using concept cartoons also provides information about the mathematical language and argumentation of future teachers. What is important here is to use the mother tongue and mathematical language in harmony. Because while creating a concept cartoon, it is

necessary to choose the focus of the mathematical task in the background, determine the accuracy of each speech bubble, and check the formal features, language structure, expression disorders, and language features that provide correct transfer of the texts in the speech bubbles (Fernández-Verdú et al., 2022; Samková, 2019a; Samková, 2019b; Samková, 2020). Henceforth, this research is anticipated to make a valuable contribution to the corpus of pedagogical content knowledge studies by shedding light on the non-routine problem-solving acumen of aspiring primary pre-service teachers, their aptitude for problem posing, as well as the multifaceted dimensions encompassing the content, structural organization, lexicon, language application, and mechanical attributes characterizing the texts embedded within the problem statements.

Ethics

Scientific, ethical, and citation rules were followed during the writing process of the study. No tampering was made on the collected data, and they were not sent to any other academic publication environment for evaluation. Ethical permission was obtained from the Ethics Committee of Balıkesir University of Science and Engineering Sciences (52889066/302.08.01/27445).

Author Contributions

All authors contributed equally to the study.

Conflict of Interest

There is no conflict of interest.

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What Should an Ideal Pre-Service Mother-Tongue Teacher Look Like?

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Abstract

In this study, it was tried to determine the profile of an ideal pre-service mother tongue teacher according to the views of Turkish mother tongue teachers and pre-service teachers. The data of the study were collected through a semi-structured "Characteristics of a Good Pre-Service Mother Tongue Teacher Form" created by the researchers. In this form, 5 mother tongue teachers working in Erzurum province of Turkey and 10 pre-service mother tongue teachers studying at Atatürk University Kazım Karabekir Faculty of Education, Turkish Language Teaching undergraduate program were asked what an ideal pre-service mother tongue teacher should be like. Phenomenology, one of the qualitative research methods, was used in the study. Phenomenology was chosen in this study to set a standard for what a pre-service mother tongue teacher should be like. According to the results obtained from the findings of the study, a good pre-service mother tongue teacher should be especially good in the field of communication skills. Suggestions were made together with the other results.

Key Words

Ideal pre-service mother tongue teacher • Pre-service teacher • Teacher profile

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Introduction

In the teaching profession, not only knowledge and skills are not enough, experience is also necessary. But is having these qualifications enough to be a good teacher? For this reason, answers to questions such as "Who is a qualified teacher?" and "What are the characteristics that a qualified teacher should have?" were sought. It is possible to consider the basic components of the characteristics that a teacher should have in three dimensions. These are general culture, special field knowledge, and pedagogical formation skills. In Turkey, Article 43 of the National Education Basic Law No. 1739, which entered into force in 1973, emphasizes that the teaching profession is a profession of expertise. One of the most important tasks expected of teachers is to be role models for students. Mother tongue teachers are role models in the transfer of cultural and social values. With the objective of addressing this matter, it is noteworthy that Turkey initially delineated specific "Turkish Language Teaching Special Field Qualifications," subsequently supplanted by the "General Qualifications for the Teaching Profession," as introduced by the Turkish Ministry of National Education in the year 2017 (MEB, 2017). The General Qualifications for the Teaching Profession determined in 2017 consisted of three interrelated and complementary competencies, 11 sub-competencies, and 65 competency indicators related to these competencies (Tosuntaş, 2020, p. 56). Within the scope of these competencies, the competencies expected from an ideal teacher are put forward. Based on this study, senior students in the teacher training departments of faculties of education should also be by this. Faculties of education, that train teachers, conduct Teaching Practice I and Teaching Practice II courses in different teaching programs in practice schools to provide pre-service teachers with professional competencies (YÖK, 2018). In the "Teaching Practice I" and "Teaching Practice II" courses, which are among the compulsory courses for senior students in the teacher training departments of faculties of education, students have the opportunity to do internships in secondary schools. Thus, pre-service teachers both gain experience before teaching and have the opportunity to get to know the institutions where they will work closely.

In 1982, with Decree No. 41, the responsibility for teacher training was transferred from the Ministry of National Education (MEB) to the Council of Higher Education (YÖK). As a result of the restructuring process carried out by YÖK in the faculties of education, more importance was given to teaching practices in related schools.

The Council of Higher Education made a comprehensive regulation on teacher training in 1997. This restructuring was initiated by YÖK in the 1998-1999 academic year (Küçükahmet et al. 1999, p. 45). In 2006-2007, a new regulation was introduced to update the Teacher Training Programs within the scope of the restructuring of education faculties (Şehirli, 2010, p. 551). One of these regulatory measures pertains to the cultivation of prospective teachers' capacity to effectively translate their theoretical acumen and competencies into practical application within school settings. This initiative seeks to comprehensively acquaint them with the multifaceted dimensions of the teaching profession, facilitating their holistic preparation for the vocation (Otacıoğlu, 2010, p. 82). With the restructuring process, new departments and programs that train teachers for secondary education were established in faculties of education, relations with practice schools and the Ministry of National Education were improved, teaching formation courses were reorganized and accreditation practices were initiated in faculties of education (Durukan & Maden, 2011, p. 556). The main reason for all these efforts is to train teachers who are qualified and

competent enough to meet Turkey's needs. In this context, the programs of departments in the faculties of education have been enriched by increasing the number of courses that develop students' general culture and field knowledge as well as their teaching skills and qualifications. In addition, the duration of pre-service teachers' attendance at practice schools and the number of activities have also been increased. Thus, education faculty students receiving teacher education become experienced individuals by applying the knowledge and skills they have gained through "Teaching Practice I" and "Teaching Practice II" courses. Moreover, pre-service teachers enrolled in faculties of education are anticipated to culminate their professional readiness and enhance their pedagogical aptitude through the orchestration of a diverse array of activities within the framework of Teaching Practice I and Teaching Practice II courses, conducted in collaboration with practice schools under the aegis of the Ministry of National Education.

The ideal teacher and the ideal pre-service mother tongue teacher

No teacher can be completely ideal in theory and practice (Rusu, Shoitu, & Panaite, 2012, p. 1017). Being a truly ideal teacher means that the teacher has reached such a level of perfection that he/she no longer needs to make further efforts to improve himself/herself. In a developing and changing world, this is almost impossible. The conception of the 'ideal teacher' as a concept is derived by each individual from various sources. Therefore, the vision of an ideal teacher will differ from source to source or person to person.

There are many studies on the ideal teacher in the literature. According to a study by Rusu, Shoitu & and Panaite (2012, p. 1019), the most important characteristic of an ideal teacher is to be skilled in human relations. The second characteristic is fair assessment. Even if teachers are not scoring machines, the evaluation of student performance should be objective. Subject knowledge ranked third. From the students' point of view, the ideal teacher shows expertise in the subject he or she teaches and spends a lot of time acquiring new knowledge. The fourth characteristic is the facilitation of students' intellectual development. It indicates the need for the teacher not only to know but also to know how to transmit his/her knowledge, thus answering the basic educational purpose. The last one is respect, which is expressed not only in the discussions that the teacher initiates with the students but also in the tone of voice, the courtesy felt, and the humility in communication. According to the results of this study, the relational competencies of an ideal teacher come to the fore. According to the findings of Singh et al. (2021, p. 1162), there are two main categories of ideal teachers. These are dispositional characteristics and professional knowledge of the teacher.

A study by Harley et al. (2000) on ideal teachers revealed the situation faced by teachers in comparison to the ideal teachers defined in policy. The findings showed that teachers' roles are unique and fall into six categories. These are facilitators of learning, localcharactersradministratorsodesignersner of learning programs, all-tlearnersrner and commucreatorseatorcitizensitizen. McKnight et al. (2016) examined the qualities of an effective teacher in 23 countries and concluded that teachers should have a good mastery of subject knowledge, create ways to get to know students, demonstrate a high level of professionalism, demonstrate the ability to develop productive relationships, have confidence in students, empathize with students by being patient, caring and kind. Çetin (2001) found that the ideal teacher behavior is identified as friendly, responsive, empathetic, sympathetic, sympathetic, helpful, always conscious, and sensitive to students' individual differences and general student psychology. A study by Sztejnberg et

al. (2004) found that ideal teachers are characterized as leadership, accommodating/supportive, considerate, and supportive of student autonomy. Among other relevant findings, the characteristics of a student-oriented teacher who is both a source of inspiration for the student and exhibits a high sense of closeness to the student come to the fore.

According to Arnon and Reichel (2007), the two main elements of ideal teachers are personal qualities and subject knowledge. In the study in which educational philosophers revealed various images of ideal teachers, supporting the cognitive development of students was identified as the main task of an ideal teacher (Gopal & Singh, 2020; Yunus et al., 2021). Ko and Sammons (2013) state that other important aspects include the current social, behavioral, and emotional goals and objectives of education. Pozo-Muñoz et al. (2000) identify four main factors that can define an ideal teacher: teaching competence, teaching qualities, teacher appearance, and dedication to teaching. Furthermore, the pedagogical skills of an ideal teacher should be assessed and developed to achieve the quality and standards set to improve learning performance (Boonen et al., 2014). A plethora of scholarly inquiries has been undertaken with the objective of delineating the optimal attitudes and behavioral attributes requisite for a teacher. The construction of an idealized teacher persona within the cognitive framework of students is a nuanced process, influenced by several variables, including the age, gender, and political affiliations of the students themselves (Douna et al., 2015). Furthermore, students commonly ascribe attributes to an ideal teacher, perceiving such an educator as an advocate for critical thinking, unconventional pedagogical approaches, and innovative instructional methodologies, possessed of a profound mastery within their field of expertise, and adept at the pragmatic translation of their knowledge into the pedagogical realm (Singh et al., 2021, p. 1163). In addition to the aforementioned attributes, the idealized teacher persona is also characterized by a harmonious and well-balanced personality, coupled with an unwavering commitment to the equitable treatment of students, thereby eschewing any form of prejudice or bias.

Research has shown that students prefer teachers who can teach with good content knowledge and also use technology in creative teaching. They also need to be patient, helpful, kind, fun, and positive (Bullock, 2015). Students prefer teachers who do not shout when they make mistakes and teach patiently as ideal teachers. Students prefer teachers who make them feel safe and facilitate their learning as ideal teachers (Singh et al., 2021, p. 1163). As can be seen, many characteristics of an ideal teacher are mentioned in the studies. While these characteristics differ according to students, different characteristics come to the fore according to colleagues. When we look at the literature, it is seen that there are no studies on ideal heritage language teachers. For this reason, it is thought that our study will fill a gap in the literature.

Method

Research Design

This study was planned according to phenomenology, one of the qualitative methods. Rose, Beeby, and Parker (1995, p. 1124) define phenomenology as a qualitative research method used to describe perceptions, feelings, understandings, and perspectives about a particular concept or phenomenon and to describe how this phenomenon is experienced, while Giorgi (1997, p. 236) defines it as a concept that refers to the sum of experiences. Phenomenology focuses on phenomena that we are aware of but do not have a detailed and in-depth understanding

of. For this reason, phenomenology is used for studies aiming to investigate phenomena that we frequently encounter in daily life, which are not foreign to us but whose meaning we cannot fully grasp, and creates a suitable research ground (Yıldırım & Şimşek, 2016, p. 69). Therefore, in phenomenological studies, emphasis is placed on the "phenomenon" to be researched, focusing on the participants' perceptions and perspectives on this phenomenon, how they make sense of this phenomenon, how they experience the phenomenon, and how they describe these experiences. The phenomenon in focus can be a concept, an idea, or an emotion (Tekindal & Uğuz Arsu, 2020, pp. 158-159).

It is aimed to increase the quality of language teaching by determining that there are general statements about mother tongue teachers accepted in Turkish society and that these statements are shaped and determined according to the opinions of mother tongue teacher candidates and mother tongue teachers. Primarily, in the pursuit of delineating the archetypal profile of a mother tongue teacher, an investigative approach was employed, involving the presentation of a semi-structured questionnaire to prospective pre-service educators specializing in mother tongue instruction. Subsequently, the collation of their responses ensued, with the overarching objective of constructing a comprehensive and holistic teacher profile.

As the second step of the study, the same form was presented to mother tongue teacher,s and their opinions were taken. In this study, it was aimed to reveal the profile of an ideal pre-service mother tongue teacher in line with the data obtained from mother tongue teachers and pre-service mother tongue teachers. For this reason, phenomenology was preferred in this study to set a standard for how pre-service mother tongue teachers should be.

Research Sample/Study Group/Participants

The participants of this study consisted of 5 teachers teaching Turkish in Erzurum province in Turkey and 10 prospective mother tongue teachers studying in the Department of Turkish Language Teaching in 2020-2021. The opinions of a total of 15 mother tongue teachers and prospective mother tongue teachers were taken.

Information about the participants is as follows:

Table 1.

Information about the service mother tongue teachers

	Age	Professional Experience	Gender
Service teachers	30, 34, 36, 38, 42	8, 10, 12, 13, 16	W, M, W, M, M

Table 2.

Information about pre-service mother tongue teachers

	Age	Gender
Pre-service teachers	22, 22, 22, 22, 22, 22, 23, 23, 25, 26	M, W, M, W, W, W, M, W, W, M

Research Instruments and Processes

The data for this study were obtained from interviews with 5 native language teachers and 10 pre-service mother tongue teachers studying in the Department of Turkish Language Teaching in Erzurum, Turkey in 2021-2022. The data were collected through the "Characteristics of a Good Pre-service Mother Tongue Teacher Form" prepared by the researchers. In the preparation of the interview form for the study, the opinions of the participants were collected with a semi-structured form prepared by taking the opinions of 3 Turkish language teaching experts and 3 measurement and evaluation experts.   In the initial phases of form development, due diligence was exercised in the integration of teacher competencies that are consonant with prevailing scholarly literature on the subject of societal expectations and the requisite qualifications of an adept educator.

Then, 4 questions were prepared, and preliminary interviews were conducted with 5 teachers. In line with the feedback received from the preliminary interviews, some additions were made to the form, and the form was reorganized by reviewing the points that were not understood. The revised content was reviewed with experts in Turkish language teacher training departments and the interview form was finalized in line with their suggestions and with the opinions of measurement and evaluation experts who made comments supporting the suggestions. The data of the study were collected with this finalized interview form.

Data Analysis

For data analysis, content analysis was performed. Content analysis involves the process of examining and interpreting the material systematically and in detail to reveal patterns, judgments, meanings, and themes (Berg & Latin, 2008). During content analysis, each participant's codes were formed, then the codes from all participants were compared and themes were created. The themes created and the quotes related to these themes are presented in a table. In the realm of qualitative research, the concept of credibility pertains to the veracity of the findings derived by the researcher and the congruence discerned within the statements proffered by study participants (Yıldırım & Şimşek, 2011). In ordToase credibility at the qualitative stage, long-term interaction was ensured during the study, interaction was made with the participants during the group sessions, and data diversity and process analysis were performed. In terms of consistency and confirmability, the questions and codes were sent to the field expert and common que,stions and themes were formed. In order to enTohe study is transferable, detailed descriptions and quotations are included.

Results

In this study on how an ideal pre-service mother tongue teacher should be, the data were handled as pre-service teacher and teacher views, and the data were analyzed in this context.

Findings related to the question "How would you define an ideal pre-service mother tongue teacher?"

A total of 5 teachers and 10 pre-service teachers responded to this question.

Table 3.

How would you define an ideal pre-service mother tongue teacher?

Pre-service teachers		Service teachers	
Category	Participants Code	Category	Participants Code
Professional development and advancement	PST1, PST3, PST6	Professional development and advancement	ST1, ST4
Communication skills	PST2, PST5, PST7, PST8	Communication skills	ST2, ST5
Dedication and faith	PST6, PST9, PST10	Dedication and faith	ST3

PST: Pre-service teacher   ST: Service teacher

As can be seen in Table 1, the majority of the participants consider professional development and advancement, communication, dedication, and belief skills as the characteristics that a good HLT candidate should have. Some of the answers given in this context are as follows:

PST3: "A person who follows the lessons step by step, criticizes, researches, is curious, does not hesitate to take responsibility, accesses information, is a good observer, and has gained experience."

PST5: "He/she has developed communication skills, has sufficient subject knowledge, is open to criticism and new learning, and is a good listener."

PST9: "A person who takes his/her job seriously, is responsible, follows achievements, is devoted and hardworking."

ST1: "Active, responsible, sensitive and idealistic."

ST5: "A person who combines his/her education with his/her love and transfers it to students in the most creative way."

ST3: "He/she should follow the lessons without being selfish and gain as much experience as possible."

Findings related to the question "What are the characteristics (professional beliefs, knowledge, attitudes, values, behaviors, teaching practices) of a good pre-service heritage language teacher?"

A total of 5 teachers and 10 pre-service teachers responded to this question.

Table 4.

What are the characteristics (professional beliefs, knowledge, attitudes, values, behaviors, teaching practices) of a good pre-service mother tongue teacher?

Pre-service teacher		Service teacher	
Category	Participants Code	Category	Participants Code
Beliefs about the profession	PST1, PST4, PST8	Beliefs about the profession	ST1, ST4
Information	PST3	Information	ST3, ST5
Attitudes	PST7, PST9	Attitudes	ST2, ST5
Values	PST6	Values	ST1
Behavior	PST2, PST5	Behavior	ST2, ST5
Teaching practices	PST10	Teaching practices	-

As seen in Table 2, the majority of the participants see beliefs, behaviors, and attitudes towards the profession as the characteristics that a good HLT candidate should have. Some of the answers given in this context are as follows:

PST4: "He/she should have the characteristics of a person who is curious, inquiring, researching, and believes that he/she can do this job well."

PST3: "Since they are likely to be role models, they should use up-to-date Turkish and have superior subject knowledge."

PST9: "Student teachers are students and are not expected to have high-level qualifications. If they enjoy doing this profession, they will learn even the smallest details about it and as they gain experience, they will incorporate all the features required by the profession."

PST6: "A person who can observe well, is tolerant and patient."

PST5: "He/she should avoid behaviors that may humiliate students. In addition, he/she should be an exemplary individual who has commitment and belief in his/her profession."

PSST10: "A person who loves teaching, uses learning skillfully with the constructivist approach, and can plan their classes properly and divide them according to the needs of the students, produce activities, respect students, and know their developmental expectations."

ST4: "She should be an idealistic teacher and be able to use her knowledge"

ST3: "They should be open to new methods that emerge over time."

ST5: "They should treat each student equally and prepare before starting the lesson."

ST: "Being aware of the honor and value of the profession, seeing teaching as a service rather than a profession, having a conscience, seeing teaching practice as a stepping stone for self-improvement rather than a duty are the characteristics that a good trainee teacher should have."

ST5: "They should love their job and children, make good observations, and be open to learning."

The third question of the research is divided into 2 sub-sections. The first of these questions is as follows:

"What should be the following characteristics of a good pre-service heritage language teacher?" (Write the answers to this question in the relevant section according to the characteristics given below) Findings related to the question "Physical appearance:

A total of 5 teachers and 15 pre-service teachers responded to this question.

Table 5

What should be the following characteristics of a good pre-service mother tongue teacher? (Write the answers to this question in the relevant section according to the characteristics given below) Physical appearance:

Pre-service teacher		Service teacher	
Category	Participants Code	Category	Participants Code
Clothing	PST4, PST5, PST7, PST10	Clothing	ST3, ST4, ST5
Personal Care	PST1, PST2	Personal Care	ST1, ST2
Gestures and facial expressions	PST3, PST6, PST8		
Other	PST9		

As can be seen in Table 3, the majority of the participants consider clothing and personal care as features that a good HLT candidate should pay attention to. Some of the answers given in this context are as follows.

PST4: "They should dress by the dress code and school rules."

PST2: "He/she should be a clean and well-groomed person who gives confidence to the students."

PST9: "A person who is cheerful, smiling, has a positive and moderate attitude, and reflects this in his/her gestures and facial expressions."

PST8: "Due to her/his profession, she/he should pay attention to her/his clothing, her/his diction should be appropriate, and she/he should be in an active rather than a passive position."

ST5: "She should dress neatly and in a way befitting a teacher. I think she should not dress in an exaggerated style."

ST1: "I do not find it appropriate to put physical appearance into a certain mold"

The answers given in part 2 are as follows:

"What should be the following characteristics of a good candidate mother tongue teacher?" (Please write your answers to this question in the relevant section according to the characteristics given below) Pedagogical knowledge:" question.

A total of 5 teachers and 15 pre-service teachers responded to this question.

Table 6

What should be the following characteristics of a good pre-service heritage language teacher? (Please write your answers to this question in the relevant section according to the characteristics given below) Pedagogical knowledge:"

Pre-service teacher		Service teacher	
Category	Participants Code	Category	Participants Code
Knowing the stages of development	PST3, PST4	Knowing the stages of development	ST3, ST4
Recognition of individual differences	PST5, PST9, PST10	Recognition of individual differences	-
Application of knowledge	PST1, PST7	Application of knowledge	ST1, ST5
Psychological awareness	PST2, PST6, PST8	Psychological awareness	ST2

As seen in Table 4, the majority of the participants think that a good candidate mother tongue teacher should be competent in knowing the stages of development and applying the knowledge. Some of the answers given in this context are as follows.

PST3: "He/she should know the developmental period and human psychology well, understand how to behave, and know the mental and physical development of a child."

PST5: "They should know the age range of the class. Accordingly, he/she should know the learning levels of the students and how they can learn. They should have prior knowledge about the class level."

PST1: "They should be a teacher who is aware that education is not only at school but also in all areas of life. Therefore, they should be able to apply their pedagogical knowledge to all areas of life."

PST6: "They should be pedagogically competent and should be interested not only in students' academic achievements but also in their psychological conditions."

ST2: "What is more important than knowing is to convey it correctly and pedagogical knowledge makes this possible."

Discussion, Conclusion & Suggestions

According to the results of Table 1, most of the participants consider professional development and advancement, communication, dedication, and belief skills as the characteristics that a good HLT candidate should have. Based on the studies conducted by Rusu, Şoitu & Panaite, (2012); Singh et al., (2021); Çetin, (2001); and McKnight et al. (2016), we see that the results obtained in this study are parallel and the results supported. This circumstance fosters a prevalent perspective wherein the conception of an exemplary candidate for the role of a mother tongue teacher encompasses a strong emphasis on comprehensive training, with particular accentuation on the cultivation of adept communication skills. Furthermore, the prominence accorded to the quantity and caliber of initiatives such as coursework, extracurricular activities, and theatrical performances designed to enhance communicative proficiencies within the undergraduate educational framework becomes increasingly salient. First of all, the candidate's mother tongue teacher should be able to express herself/himself. Then they should be able to communicate effectively with their students.

As can be seen in Table 2, the majority of the participants consider beliefs, behaviors, and attitudes towards the profession as the characteristics that a good pre-service mother tongue teacher should have. These results show that a pre-service mother tongue teacher should believe in the teaching profession (Douna et al., 2015). The way the pre-service mother tongue teacher behaves towards the students was also found to be an important result. In this regard, according to the opinions of both pre-service mother tongue teachers and mother tongue teachers, the teacher should be very careful in his/her behavior towards the students. Conversely, the establishment of a partition between the student and the educator is imminent. It is noteworthy to underscore that instructors who exhibit affability, perceptiveness, and concurrently, empathy, are more likely to foster harmonious and productive interactions with their students. The assertions made by Çetin (2001), Boonen et al. (2014), and Ko and Sammons (2013) corroborate and accentuate these thematic elements in their respective scholarly investigations.

According to Table 3, the majority of the participants think that clothing and personal care are the characteristics that a good candidate mother tongue teacher should pay attention to. When the answers given by the participants are analyzed, it is noteworthy to be formal, especially in terms of clothing. It is seen that well-groomed and clean teachers will give more confidence to the students and are important for communication to be established. In addition, the ability to use body language effectively is one of the prominent results. Within the sphere of the teaching profession in Turkey, there exists no uniform standardization regarding attire, allowing educators a degree

of latitude in their sartorial choices, provided that their selections remain within the bounds of professional decorum. This particular facet of a teacher's appearance has been underscored by Pozo-Muñoz et al. (2000) in their scholarly investigation.

According to Table 4, the majority of the participants think that a good candidate mother tongue teacher should be competent in knowing the stages of development and applying the knowledge. Pedagogical formation competence is one of the most important issues for the teaching profession. As in almost every field, the ability of an individual to explain what he/she knows in the right way is even more prominent in the teaching profession. A teacher or a pre-service teacher may know a subject very well, but if he/she does not have the skills to explain it, he/she is considered incomplete in terms of pedagogical formation. Singh et al. (2021); Harley et al. (2000); McKnight et al. (2016); Çetin (2001); Sztejnberg et al. (2004); Arnon and Reichel (2007); (Bullock, 2015) emphasized teachers' ability to teach in their studies. The precise and efficacious transmission of knowledge assumes a paramount role in the skill set of educators. In light of these data, the study delineates a compelling dimension concerning the significance of individual variances and the cultivation of psychological acumen by prospective mother-tongue teachers.

1- Pre-service mother tongue teachers' deficiencies in communication skills should be overcome. Necessary changes should be made in the undergraduate curriculum and individual differences should be taken into consideration.

2- It is important for pre-service mother tongue teachers to be careful about dressing for communication with students. At this point, a standard for dressing can be established.

3- No matter how good the field knowledge of the mother tongue pre-service teacher is, pedagogical competence should be given importance. He/she should take the necessary precautions at the point of transferring knowledge and recognizing the other person.

Ethic

The approval of the ethics committee regarding the compliance of the research with the ethical rules was obtained from the Atatürk University Legal Consultancy Office with the decision dated 19/03/2021 and numbered 29202147-300-E.2100068931.

Participants participated in this study voluntarily. A form was signed by the participants stating that they participated in the study.

Author Contributions

All authors contributed in the same proportion.

Conflict of Interest

There is no conflict of interest between the authors.

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A Study on Sustainable Living Awareness of Gifted Secondary School Students

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Abstract

Problems such as global warming, epidemics, social inequalities, poverty, drought, forest fires and food inadequacy in the world today have led to an increase in people's concerns about the future. The way to eliminate the worries of human beings about the future is through a sustainable living. The aim of this study is to improve the awareness of gifted students about sustainable living through environmental education carried out in out-of-school learning environments. Mixed method was used in the research. The participants of the research are 25 gifted students selected by criterion sampling method. The " Sustainable Living Awareness Scale" developed by Akgül & Aydoğdu (2020) and the questionnaire developed by the researchers were used as data collection tools. Wilcoxon Signed Rank Test was used in the analysis of quantitative data and content analysis method was used in the analysis of qualitative data. The research findings indicate that, it was determined that environmental education positively improved students' awareness of sustainable living. It is thought that environmental education will contribute to the development of various behaviors in order to support sustainable living.

Key Words

Environmental education • Nature education • Sustainable living

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Introduction

Global warming, pandemics, social inequalities, forest fires, food shortage and other issues that affect the entire world have led people to think about and worry about the present and the future. This situation has increased the importance given to sustainability, as defined for the first time in the Report of the World Commission on Environment and Development (United Nations, 1987) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs (p.24)," and has led countries around the world to take measures related to sustainability. Within the United Nations (UN), numerous studies have been conducted on sustainability and various decisions have been made since 1987. The most important of these decisions is the "Transforming our world: The 2030 Sustainable Development Agenda with 17 Sustainable Development Goals" adopted at the United Nations Sustainable Development Summit held in New York in September 2015. In the context of this agenda, goals have been defined as follows (1)Ending povertying (2) Ending hunger (3) Human health and well-being (4) Quality education for all (5) Social gender equality (6) Availability and sustainability of water and sanitation services for all (7) Accessible and clean energy (8) Decent human dignity jobs and economic development (9) Industry, innovation and infrastructure (10) Reducing inequalities (11) Sustainable cities and societies (12) Sustainable consumption and production (13) Climate change (14) Protection of underwater life (15) Protection of terrestrial ecosystems (16) Ensuring peace and justice and building institutions that cover these situations (17) Expressed targets have been determined as cooperation to achieve the targets, and progress in this direction is followed every year with various reports.

In schools, the concept of sustainability is often emphasized over the concept of sustainable development (Walshe, 2008). For this reason, the research was carried out on the concept of sustainability. The concept of sustainability consists of environmental, social and economic sustainability dimensions that interact with each other (Berglund & Gericke, 2016; Giddings et al., 2002; Holmberg & Sandbrook, 1992). The three dimensions are presented as a diagram in Figure 1.

Figure 1.

Sustainability Dimensions
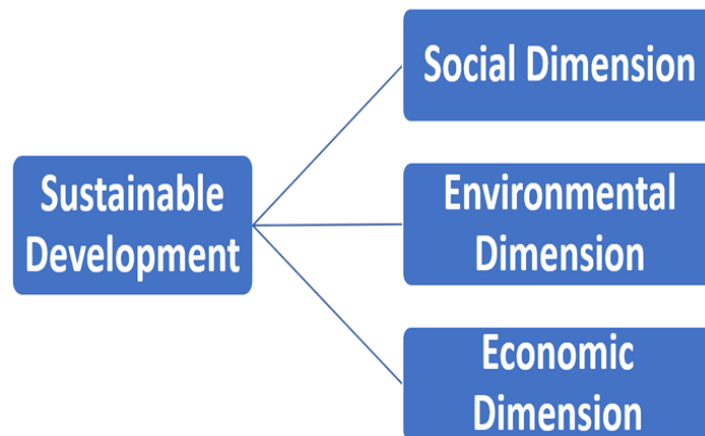
These dimensions are described as follows (Barbier, 1987; Harris, 2000; Holmberg & Sandbrook, 1992)

• Social Dimension: A socially sustainable system supports social justice, gender equality, cultural diversity, ensures the adequate provision of social services, including health and education, and encourages participation in policy and decision-making processes.

• Environmental Dimension: An environmentally sustainable system ensures the careful and conscious use of natural resources, the conservation of biodiversity and balance in the ecosystem, and the use of renewable energy sources.

• Economical Dimension: An economically sustainable system consistently produce goods and services, ensures that basic needs are met or poverty is alleviated, avoid extreme imbalances that harm production, be in harmony with nature and the environment, and support the development of the regional and local market.

Considering these three dimensions, the role of education in ensuring sustainability is recognized on international platforms. At the 1972 United Nations Conference on the Human Environment held in Stockholm, the importance of environmental education was emphasized and the importance of education for sustainability was emphasized in all subsequent conferences and meetings including topics such as the environment and sustainability (Dyment et al., 2015). In order for human beings to lead sustainable lives, they need to design their lifestyles, technologies, and social institutions in harmony with the potential of nature (Capra, 2007). Individuals also require education on sustainability issues to embrace a sustainable lifestyle (Walshe, 2017). It's emphasized that education is a fundamental element in achieving sustainability goals (Bulut & Çakmak, 2018). In this context, attention has been drawn to the relationship between environmental education and sustainability education (Johnson, 2011; Summers et al., 2004; Kagawa, 2007; Wesselink & Wals 2011). Environmental education has been demonstrated to provide a future perspective on sustainability (Tilbury, 1995) and to play a key role in its attainment (McKeown, 2002; Green & Somerville, 2015). However, it has been emphasized that environmental education has become one of the important goals of sustainability education (Ärlemalm-Hagsér & Sandberg 2011; Eilam & Trop 2010). When addressing sustainability issues in educational settings, it is also emphasized that it is important to consider the environmental, economic and social dimensions of sustainability as a whole (Summers & Childs 2007; Warburton 2003). In addition, the realization of sustainability education not only in formal and formal education environments but also in informal and non-formal education environments together with various activities increases the quality of education (Tanrıverdi, 2009). It has been determined that trainings carried out in informal learning (out-of-school) environments are important for sustainability education (Clarke & Mcphie, 2014), contribute to the sustainable protection of nature and the environment (Sellmann, 2014) and , in addition to the experiences provided by out-of-school education practices contribute to the addressing of social, economic and environmental sustainability issues (Hill, 2012). Out-of-school learning environments can play an effective role in education through the use of different teaching strategies for students and the creation of interdisciplinary learning opportunities (Asfeldt et. al., 2021).

Sustainability education enables individuals to change their consumption habits for a sustainable future in a world where resources are rapidly depleting. It also instills positive attitudes and values towards solving global problems (Bulut & Çakmak, 2018). Therefore, providing sustainability education in schools and critically addressing the concept of sustainability through questioning, reflection, discussion, and criticism is crucial (Walshe, 2017). It has

been observed that sustainability education enhances students' understanding of sustainability and encourages them to examine the relationship between sustainability and their own lives (Walshe, 2013; Mahat & Idrus, 2016). Moreover, sustainability education not only enhances students' roles in terms of their consumption preferences regarding sustainability but also increases their awareness of sustainability. It encourages students to make individual behavior changes like energy and water conservation, sustainable purchasing, and transportation options (Lewis et al, 2019). Environmental education conducted with students about thesustainable living of organisms (such as frogs) has been found to contribute to students' understanding of the concept of sustainable living and the impact of human intervention on the habitats of living organisms (Hudson, 2007). Furthermore, in sustainability education, it has been observed that students make inferences about the social, economic, and environmental dimensions of sustainability (Walshe, 2008). In a study conducted by Walshe (2017), students were found to emphasize the social and economic dimensions of sustainability, although their primary focus was on the environmental dimension. Similarly, in a study conducted by Demir & Atasoy (2021), students were found to focus on the environmental dimensions of sustainability but also demonstrated a positive attitude towards its social and economic dimensions. Consistent with these findings, research by Fiedler et al. (2023) and Kagawa (2007) indicated that students often associate sustainability more with the environment and environmental issues.

Sustainability topics have been found to be closely related to the specific objectives, achievements, skills, and values of the social studies curriculum (Kaya & Tomal, 2011; Oğuz Hacat & Demir, 2019; Yalçın, 2022). It has been noted that the social studies curriculum includes objective statements related to the environmental, social, and economic dimensions of sustainability (Kardaş İşler, 2023). Furthermore, it has been emphasized that the Social Studies course is a very important subject for imparting the social, environmental, and economic dimensions of sustainability to students (Azrak, 2022). In addition to the Social Studies curriculum, it has been determined that the Science Curriculum is also related to sustainability (Ateş, 2019). Both the Social Studies Curriculum and Science Curriculum include the common concepts of "nature, natural resources, and sustainability" (Demirezen & Kaya, 2022). Moreover, when examining studies related to sustainability, it has been found that the subject of sustainability is particularly investigated in connection with science and social studies education (Aktaş et al., 2020; Aytar & Özsevgeç, 2019; Bulut & Çakmak, 2018; Yıldırım, 2020).

The importance of this research is providing an environmental education in out of school environments to gifted students with the aim of raising awareness about sustainable living. Obtaining detailed inferences about the changes that gifted students will show towards the social, environmental and economic dimensions of sustainability with this education will be insightful in arranging the environments where sustainability education will be given. The ultimate goal is to demonstrate the necessity of organizing and conducting environmental education in out-of-school environments for the purpose of instilling sustainable living awareness in students. This study, by employing various educational approaches and designing environmental education in the context of subjects covered in social studies and science courses, investigates the impact of this education on the sustainable living awareness of gifted students. In line with this objective, the following research questions were addressed:

● Is there a significant difference in the pre-test and post-test scores of the Sustainable Living Awareness Scale and its dimensions among gifted students who participated in environmental education?

● How do the sustainable living awareness levels of gifted students change throughout the course of the education?

Method

Study Design

In order to determine and thoroughly examine the awareness of gifted students participating in environmental education towards sustainable living, this study was conducted as a mixed-methods research. Within the framework of the convergent parallel design of mixed methods, both qualitative research designs such as phenomenology and quantitative research designs like a single-group pretest-posttest quasi-experimental design were employed. The convergent parallel design involves giving equal priority to both qualitative and quantitative data to comprehensively investigate the research problem, with the data being separately analyzed and then integrated during interpretation (Plano Clark & Creswell, 2015). In this study, data collection instruments were administered to students before and after the experimental procedure, and the data were analyzed separately and then interpreted together.

Study Group

A total of 25 gifted students attending middle schools in Istanbul province were participated in the study. The decision to have a study group of 25 individuals was made due to the experimental nature of the study and the need for effective implementation of activities in small groups. The criterion sampling method was used in the selection of students. Criteria considered for selection included being identified as gifted, gender, high interest in the environment, voluntary participation, and completion of the sixth grade. Gifted individuals have higher levels of environmental perception compared to typically developing individuals; they tend to be curious, observant, problem-finders, and solution developers (Johnsen, 2011; Meador, 2003). Therefore, the most fundamental criterion in determining the study group is being gifted individuals. The reason for selecting 6th grade students is that they have a basic level of knowledge about the environment and environmental issues in the curricula of life sciences, social studies, and natural sciences. To ensure gender equality, efforts were made to maintain balance between female and male students. Out of 125 students, 25 were selected for the study, consisting of 14 female and 11 male students..

Data Collection Tools

Quantitative Data Collection Tool

To determine the awareness of gifted students participating in environmental education regarding sustainable living, the "Sustainable Living Awareness Scale" developed by Akgül and Aydoğdu (2020) was used as the quantitative data collection tool. Akgül and Aydoğdu (2020) developed this scale by reviewing the literature in the field and obtaining expert opinions during item writing. They collected data from 319 students for reliability analyses. After factor analysis, the final version of scale was prepared, which consists of 20 items in total, with 10 positive and 10 negative statements, using a three-point Likert scale. The structure of scale consists of 7 items in the environmental dimension, 5 items in the economic dimension, and 8 items in the social dimension. The internal

consistency reliability coefficient of the scale, calculated using Cronbach's alpha, is .77. Table 1 presents the dimensions of the scale and the Cronbach's alpha internal consistency reliability coefficients.

Table 1.

Scale Dimensions and Internal Consistency Reliability Coefficient

Dimension	Items	Cronbach's alpha
Social	20, 21, 22, 23, 24, 28, 32, 36	.76
Environmental	5, 7, 10, 11, 12, 13, 19	.73
Economic	38, 41, 43, 46, 48	.69

The " Sustainable Living Awareness Scale" was administered to the participants both before and after the environmental education program.

Qualitative Data Collection Tools

To explore the reasons for the changes in the awareness of gifted students regarding sustainable living as part of the qualitative aspect of the study, a data collection tool consisting of three questions was used in the form of a questionnaire. The participants' written responses were collected to examine these reasons. The questionnaire, developed by the researchers taking into account the "Sustainable Living Awareness Scale" items, was presented to three faculty members for their opinions and suggestions. Subsequently, it was applied to five middle school students to finalize its form. The questionnaire includes the following three questions:

1. "In your opinion, what is sustainable living?"

2. "What can be done to support sustainable living?"

3. "What support and behaviors do you think you have regarding sustainable living? (before training) / What support and behaviors do you think you will have regarding sustainable living after the education? (after training)"

These questions were administered to the participants before and after environmental education.

Data Analysis

Quantitative Data Analysis

The positive items on the "Sustainable Living Awareness Scale" were scored as "Agree (3)", "Undecided (2)", and "Disagree (1)". For the negative items, their scores were reverse-coded. By reversing the negative items, scores ranging from a minimum of 20 to a maximum of 60 were obtained from the scale. IBM SPSS 21.0 software was utilized for the analysis of the data collected through the scale. Prior to selecting the statistical methods for the analysis of quantitative data, it was essential to assess whether the data followed a normal distribution. To check for normality, histogram graphs and skewness coefficients for each measurement were examined. To check whether the assumption of normality was met, the researchers examined the histogram graphs and skewness coefficients for each measurement. Additionally, since the sample size was less than 50 (n<50), the Shapiro-Wilk test, which is more

powerful in such cases (Mayers, 2013), was used to assess the normality of the scores. Since the analysis revealed that the data did not adhere to a normal distribution, non-parametric tests, specifically the Wilcoxon Signed-Rank Test, were employed to compare the pre-test and post-test scores.

Qualitative Data Analysis

In the analysis of the qualitative data obtained from the questionnaire used in the study, content analysis was employed. The data obtained were categorized according to the dimensions of the "Sustainable Living Awareness Scale", which are social, environmental, and economic dimensions. Three researchers independently coded all the data, created categories, compared codes and categories, and discussed them to reach consensjus on codes and categories (Ültay et al., 2021). Codes were presented in the form of frequency and percentage tables. The quantification of qualitative data involves converting written data obtained through interviews, observations or document analysis into numbers and figures. The purpose of quantifying qualitative data includes increasing the reliability and reducing bias. Quantifying qualitative data is considered a form of data analysis and allows for fairer interpretations of results (Yıldırım & Şimşek, 2013). The reliability calculation between the researchers was determined using Miles and Huberman's (2015) formula. The reliability coefficient is calculated using the formula: Agreement / (Agreement + Disagreement) x 100. The reliability coefficient between the researchers was calculated as 84% for the pre-application questionnaire and 94% for the post-application questionnaire. These values indicate that the research data analysis is reliable (Miles & Huberman, 2015).

Application Process

The students participating in the study engaged in various activities during the 6-day sustainable-focused environmental education program, which covered environmental issues, proposed solutions to these problems, and interdisciplinary perspectives on sustainable living. The integration of disciplines such as physics, chemistry, biology, geography, linguistics, painting, music, philosophy, history, engineering and mathematics in the context of environmental issues has been achieved through activities based on STEM, experiments, field research, creative drama and educational games. These activities specifically targeted the three dimensions of sustainability: social, environmental and economic. Topics covered during the activities included water resources, renewable energy sources, biodiversity, maintaining balance in ecosystems, recycling and recovery, population growth, deforestation, and the importance of forests. In total, 19 activities related to sustainable living were conducted. Each activity was conducted in learning groups with varying numbers of participants, based on the applied instructional approach.

The activities were specifically designed, taking into consideration the three dimensions of sustainable living: social, environmental, and economic dimensions. The aim was for students to make observations and draw conclusions through experiments in education, to conduct in-depth examinations of events causing environmental pollution through practical activities, to gain insights into concepts such as biodiversity, ecosystems, and material cycles through field trips, and to use mobile applications to gain an understanding of various ecological footprints and determine their own ecological footprint. These activities aimed to not only raise students' environmental awareness (dimension) but also promote social awareness (dimension). They helped students understand the importance of natural resources for society, connect the concept of sustainability with different disciplines, make

inferences about issues affecting society, express the significance of sustainability for society through various professions, and blend sustainability with art to unleash their creativity. These activities also aimed to instill economic awareness (dimension) in students. They drew attention to the necessity of conserving resources while using them, proposed economic solutions to environmental issues, provided ideas for different designs, and emphasized the importance of leaving a more livable environment for future generations through mathematical calculations.

Findings

Quantitative Findings

To investigate whether there is a significant difference between the pre-test and post-test "Sustainable Living Awareness Scale" scores and dimension scores of gifted students participating in environmental education, the scale was administered both before and after the education. Table 2 presents the descriptive statistics results for the entire scale and its dimensions.

Table 2.

Descriptive Statistics for Sustainable Living Awareness Scale and Its Dimensions

Dimension	Test	N	Mean	SD	Min	Max
Social	Pre-Test	25	21.04	3.00	10	24
	Post-Test	25	21.96	2.76	14	24
Environmental	Pre-Test	25	18.24	2.86	9	21
	Post-Test	25	19.12	1.76	15	21
Economic	Pre-Test	25	12.68	2.15	6	15
	Post-Test	25	13.88	1.48	10	15
Total	Pre-Test	25	51.96	6.43	25	58
	Post-Test	25	54.96	4.29	41	60

As shown in Table 2, there has been an increase in the average scores for the social, environmental, economic dimensions and the total score of the scale in favor of the post-tests. It is also noted that there has been an increase in the minimum scores obtained in all categories for the post-tests.

In order to determine whether the data obtained from scale exhibit a normal distribution, the Shapiro-Wilk Test was applied and the results are presented in Table 3.

Table 3.

Results of the Shapiro-Wilk Test for Scale Pre-Test and Post-Test Scores

Test	N	Mean	SD	p
Pre-Test	25	51.96	6.43	.000
Post-Test	25	54.96	4.26	.001

The results of the Shapiro-Wilk test, as presented in Table 3, indicate that the pre-test and post-test data are not normally distributed ($p < 0.05$). Therefore, for data analysis, the non-parametric test, the Wilcoxon Signed-Rank Test, was employed (Table 4).

Table 4.

Wilcoxon Signed Rank Test Results for the Comparison of Scale Pre-Test - Post-Test Scores

Dimension	Pre-test-Post-test	N	Mean Rank	Sum of Ranks	z	p
Social	Negative rank	4	11.25	45.00	-2.041	.041
	Positive rank	15	9.67	145.00		
	Equal	6				
Environmental	Negative rank	7	9.79	68.50	-1.077	.282
	Positive rank	12	10.13	121.50		
	Equal	6				
Economic	Negative rank	3	10.00	30.00	-2.899	.004
	Positive rank	17	10.59	180.00		
	Equal	5				
Total	Negative rank	4	12.25	49.00	-2.716	.007
	Positive rank	19	11.95	227.00		
	Equal	2				

As seen in Table 4, a statistically significant difference ($p < 0.05$) was identified between the pre and post-test average scale scores of the students participating in environmental education. It was determined that this observed difference was in favor of the positive rank, that is, the post-test application. The results indicate that there was a statistically significant difference in the social and economic dimensions of the scale in favor of post-test ($p < 0.05$). In the environmental dimension, no statistically significant difference was found ($p > 0.05$). However, when

comparing the students' pre-test mean score for the environmental dimension (18.24) with their post-test mean score (19.12), it is apparent that the education had a positive effect.

Qualitative Findings

In order to examine the change in the awareness of gifted students participating in environmental education regarding sustainable living during the education, a questionnaire consisting of three questions was applied to the students before and after the application. The data obtained were categorized according to the social, environmental and economic dimensions of the Sustainable Living Awareness Scale.

In the research, students were asked "In your opinion, what is sustainable living?". The findings obtained from the answers given to the question before and after the training are presented in Table 5.

Table 5.

Findings Regarding Students' Definitions of Sustainable Living

Before Training					
Category	**Code**	**f**	**%**	**Total (f)**	**Total (%)**
Social	Livable Environment	3	12	9	36
	Living without injustice	3	12		
	Current life	2	8		
	Healthy life	1	4		
Environmental	Recyclable lifestyle	5	20	9	36
	Life in which natural balance is maintained	2	8		
	Life formed with biodiversity	1	4		
	Life that sustains the life of animals, plants, and humans	1	4		
Economic	Using natural resources economically	5	20	5	20
Other	Don't know	2	8	2	8
After Training					
Category	**Code**	**F**	**%**	**Total F**	**Total %**
Social	A life that requires thinking about the future and can continue for generations	7	28	13	52
	Clean, healthy, livable world	6	24		
Enviromental	Living with environmental continuity	6	24	20	80
	Living in harmony with nature	6	25		
	Living that supports reuse	5	20		
	Living organisms in their own ecosystems	3	12		
Economic	Renewal and continuity of resources	9	36	9	36

When the findings in Table 5 are evaluated, expressions regarding how the students participating in environmental education define sustainable living are seen before and after the education.

As can be seen from the table, there was an increase in the answers related to the three dimensions in the sustainable living awareness scale in the definition of sustainability before and after the training. It is seen that in addition to the increase in the rate of answers after the training, the answers given afterwards also differ. Before the training, students used the expressions "livable environment", "living without injustice", "current life" and "healthy life" in the definition of sustainability. These statements are associated with the social dimension of sustainability. The expressions of "A life that requires thinking about the future and can continue for generations" and "a clean, healthy, livable world" are also given under this heading after training. In the definition of sustainability used before training, the expressions "recyclable lifestyle", "life in which natural balance is maintained", "life formed with biodiversity" and "life that sustains the life of animals, plants, and humans" are associated with the environmental dimension of sustainability. After training " living with environmental continuity", "living in harmony with nature", "living that supports reuse" and "living organisms living in their own ecosystems" are the responses of students indicate different definitions. The expression of "using natural resources economically" given to the question before the training and the expression of "renewal and continuity of resources" given after the training are associated with the economic dimension of sustainability.

Although there is not much variation in the responses of this question, the response rate has been increased. Students who stated that they did not know the definition of sustainability before the training also gave acceptable answers to the question after the training. Before the training, Student 13 answered the question as, "*In my opinion, sustainable living means that people can live more comfortably and healthily and meet their needs naturally. (This is the first time I've heard of the concept.)*" and after the training, "*Sustainable life is a way of life where people use resources without wasting them, recycle them, and are conscious.*" Student 2 answered before the training as "*People should live their lives in a healthy way.*" and after the training, "*All resources are sufficient for the living things in that region and the living things live in that area.*"

In the research, students were asked "What can be done to support sustainable living?". The findings obtained from the answers given before and after the training to the question are presented in Table 6.

Table 6.

Findings Regarding What Students do to Support Sustainable Living

Before Training					
Category	**Code**	**f**	**%**	**Total (f)**	**Total(%)**
Social	Awareness activities	3	12	3	12
Environmental	Contributing to recycling	5	20	18	72
	Protecting natural resources	5	20		
	Protecting nature	5	20		
	Turning to renewable energies	3	12		
Economic	Using resources economically	4	16	4	16
After Training					
Category	**Code**	**f**	**%**	**Total f**	**Total %**
Social	Awareness activities	6	24	6	24
Environmental	Protecting nature	5	20	24	96
	Contributing to recycling	5	20		
	Protecting natural resources	4	16		
	Turning to renewable energies	3	12		
	Creating green cities	3	12		
	Providing the best environment for living things	2	8		
	Protecting living things	1	8		
	Trying to reduce global warming	1	4		
Economic	Using resources economically	7	28	8	32
	Making different designs for the purification of resources	1	4		

Table 6 includes statements about what students do to support sustainable living. As can be seen from the table, there has been an increase in the answers related to the three dimensions in the sustainable living awareness scale regarding what to do to support sustainable living before and after the application. They stated that they carry out

"awareness activities" about what students do to support sustainable living before and after the training. This statement is associated with the social dimension of sustainability. It is seen that the rate of use of this expression increased after the training. Before the training, the students' activities to support sustainable living include "contributing to recycling", "protecting natural resources", "protecting nature" and "turning to renewable energies", and after the training, the expressions "protecting nature", "contributing to recycling", "protecting natural resources", "turning to renewable energies", "creating green cities", "providing the best environment for living things", "protecting living things" and "trying to reduce global warming" are associated with the environmental dimension of sustainability. This finding shows that students' response rates increased after the training, as well as their answers diversified. Before and after the training the statement of "using resources economically" and the statement of "making different designs for the purification of resources" after the training question are associated with the economic dimension of sustainability.

Although there is not much variation in the responses of this question, the response rate has increased. Student 3 answered as, "*Information about recycling can be given*" before the training. After the training, the same student responded as "*Not to waste natural resources, not to pollute nature, to recycle waste, to carry out awareness-raising activities.*" Student 7 replied as "*Conscious use of energy resources can be taught*" before the training. After the training the student replied as "*Resources should be consumed without being polluted and/or wasted, recycling should be supported, and waste collection points should be increased. In addition, different designs should be made for the purification (cleaning) of resources.*"

In the research, students were asked " What support and behaviors do you think you have regarding sustainable living? (before training) / What support and behaviors do you think you will have regarding sustainable living after the education? (after training)". The findings obtained from the answers to the questions before and after the training are presented in Table 7.

Table 7.

Findings Regarding the Support and Behaviors Students have/will have to Support Sustainable Living

Before Training

Category	Code	f	%	Total (f)	Total (%)
Social	I attended the seminar	5	20	5	20
Enviromental	I collect garbage	6	24	14	56
	I contribute to recycling	5	20		
	I protect living things	3	12		
Economic	I don't waste resources	6	24	6	24
Others	I do not engage in any behavior	3	12	3	12

After Training

Category	Code	f		Total f	Total %
Social	I will work to raise awareness of my environment.	7	28	10	40
	I will give seminars	3	12		
Environmental	I will protect nature and the environment	7	24	24	96
	I will contribute to recycling	4	16		
	I will protect natural resources	4	16		
	I will protect the trees	2	8		
	I will pay attention to tree species	2	8		
	I will contribute to the formation of green cities	2	8		
	I will take part in renewable energy projects	2	8		
	I will respect nature	1	4		
Economic	I will use natural resources economically	10	40	10	40

As seen in Table 7; after the training, students stated with more expressions that they would support sustainable living. This finding shows that the education received positively affects the students. As seen in the table, there has been an increase in the answers to the questions related to the three dimensions in the sustainable living awareness

scale. It is seen that students who stated that they did not engage in any behavior that supports sustainable living before training also answered the question after the application. It is seen that in addition to the increase in the rate of answers after the training, the answers given afterwards also differ. Among the answers in which the students expressed their support and behavior towards sustainable living before the training, the statement of "I attended the seminar" and among the answers in which they expressed their support and behavior towards sustainable living after the training, the statement that "I will work to raise awareness of my environment" and "I will give seminars" are associated with the social dimension.The statements given before the training "I collect garbage, I contribute to recycling, I protect living things" and after the training, the statements given "I will protect nature and the environment", "I will contribute to recycling", "I will protect natural resources", "I will protect trees", "I will contribute to the formation of green cities", I will take part in renewable energy projects" and "I will respect nature" are associated with the environmental dimension. The statements given to the question before and after the training: "I don't waste natural resources" and "I will use natural resources economically" are also associated with the economic dimension of sustainability.

There are variations in the responses of this question and the response rate has increased. Students who stated that they did not provide support or behavior regarding sustainable living before the training also gave acceptable answers to the question after the training. Student 3 replied the question as "*I attended some recycling programs and seminars*" before the training. The same student replied as"*I will be more careful not to pollute nature. I will share what I have learned with everyone, attend conferences, go to the forest more often, and pay attention to tree species. I will try to raise everyone's awareness. I will take my family to the Arboretum. I will recommend this event to everyone. It was a highly enjoyable event. I will pay attention to blue, green and gray water footprints and conserve water. I will give more importance to writing poetry. I will get more information on these subjects.*" after the training. Student 13 answered the question before the training as " *I do not throw any of my garbage in the streets. I throw it in the garbage on the street or at home. I especially try to use water and electricity consciously.*" "After the training the student answered as "*I will continue to do the same things as I wrote in the previous form, that is, I cannot express it with words at the moment, but over time, I will look at the events I encounter in more detail.*"

Conclusion, Discussion & Suggestions

The findings obtained from the study, which was carried out as a mixed-method research to determine and thoroughly examine the awareness of gifted students who participated in environmental education conducted in an out-of-school setting with an interdisciplinary approach using various learning methods towards sustainable living, reveal that the participants' awareness of sustainable living has developed positively.

Within the scope of the research, it is obvious that students' awareness and approaches towards sustainability were improved through environmental education in nature (out-of-school settings). This shows that sustainability education through environmental education (in out-of-school settings) is effective. This result obtained in the study is supported by Hudson (2007), who found that environmental education contributed to students' understanding of the concept of sustainable living in a study on the sustainable living of living things (frogs). Likewise, it has been determined that education in informal learning (out-of-school) settings is crucial for sustainability education (Clarke

& Mcphie, 2014), contributing to the sustainable preservation of nature and the environment (Sellmann, 2014) and addressing environmental sustainability issues (Hill, 2012). Tanrıverdi (2009), on the other hand, emphasizes that the realization of sustainability education with various activities in informal and non-formal education settings increases the quality of education. When evaluated in this direction, it can be said that the environmental education was effective in developing students' awareness and approaches to sustainability.

According to the results of the pre-test and post-test applied for sustainable living before and after the training sessions, students' scores in the social and economic dimensions of sustainability showed a significant improvement in favor of the post-test. However, no significant difference was found for the environmental dimension. In the interviews conducted with the students before and after the trainings within the scope of the research, it was determined that the students' perceptions and approaches towards all dimensions of the concept of sustainability differed, but their emphasis on the environmental dimension was at a higher level both before and after the trainings. In this case, the reason for the lack of a significant difference in the pre-test and post-test applied within the scope of the research on the environmental dimension of sustainability can be explained by the fact that the students have more experience in environmental sustainability and the education they have previously received on environmental issues. As a result, it is seen that the trainings conducted within the scope of the research contributed to the development of students in the social, economic, and environmental dimensions of sustainability; however, students associated sustainability more with environmental issues. This result is similar to the results of the studies that sustainability trainings contribute to students' perceptions about the social, economic and environmental dimensions of sustainability (Walshe, 2008), students emphasize the social and economic dimensions of sustainability, but their main focus is on the environmental dimension (Walse, 2017), students focus on the environmental dimensions of sustainability (Demir & Atasoy, 2021), and students associate sustainability more with the environment and environmental problems (Fiedler et al., 2023; Kagawa, 2007). This shows how important it is to include all dimensions of sustainability in sustainability education.

As a result of the analysis of the written responses received from the students before and after the trainings, it was determined that the students' perspectives on the concept of sustainability differed and their perceptions of the concept of sustainability changed positively. These results obtained in the study support the results of Walshe (2013) and Mahat and Idrus (2016) that sustainability trainings improve students' understanding of sustainability. Likewise Lewis, et al. (2019) found that sustainability education increased students' roles related to sustainability in terms of consumption preferences and their awareness of sustainability, which supports the results of the research. This shows how important it is to implement trainings planned within the scope of sustainability in developing students' awareness of sustainable living. As a result of the analysis of the written responses received from the students, it was concluded that the students emphasized the social, economic, and environmental dimensions of the concept of sustainability in order to support sustainable living and supported sustainable living with their behaviors. Students' behaviors to support sustainable living differed before and after the trainings. These results are similar to the study conducted by Lewis et al. (2019), in which sustainability trainings led to behavioral changes such as energy and water saving, sustainable purchasing, and transportation options. In this direction, Arısoy (2021) determined the positive effect of STEM activities on students' acquisition of sustainable living habits in his study and Külegel

(2020) concluded that STEM activities help students better understand the importance of recycling, sustainable environment and alternative energy sources, and develop creative solutions to solve environmental problems, both of which support the results of the research. Despite the fact that it was determined that students performed behaviors towards all dimensions of the concept of sustainability before and after the trainings, it was concluded that their behaviors towards the environmental dimension were at a higher level after the application. Nevertheless, the realization of sustainability education through environmental education may have led students to emphasize more on the environment. As a result, it is seen that sustainability education has led to a positive change and increase in students' behaviors towards supporting sustainable living. For this reason, sustainability education should be expanded in order for students to develop behaviors to support sustainable living.

The target group of the study consists of gifted students. In this context, it was determined that sustainability-oriented environmental education positively changed the awareness of gifted students about sustainability and their perspectives on the environment. These results are similar to the result of Ayaydın et al. (2023) that out-of-school activities improve the awareness of gifted students towards environmental problems. Similarly, in this direction, in the study conducted by Ayaydın et al. (2018), the increase in the awareness, sensitivity, and consciousness of students with gifted towards the environment through nature education activities is similar to the results of the research. In the study conducted by Mutlu et al. (2019), it was determined that the awareness scores of students with gifted regarding environmental education concepts were higher than their peers with normal development. The results obtained in the study and the results obtained in other studies show that although the sensitivity and awareness of children with gifted towards the environment are high, environmental education for students with gifted is effective. In this case, in order to raise the awareness and sensitivity of gifted students to a higher level, it is beneficial to expand the environmental education carried out with these student groups.

As a result of the research, it was determined that environmental education planned in out-of-school environments within the scope of social studies and science courses was effective in students' learning about sustainability issues. This supports the fact that sustainability issues are addressed within the scope of social studies and science courses in the studies (Aktaş et al., 2020; Aytar & Özsevgeç, 2019; Bulut & Çakmak, 2018; Demirezen & Kaya, 2022; Yıldırım, 2020). Taking into consideration the contributions of environmental education planned in out-of-school environments within the scope of social studies and science courses to students' learning about sustainability issues, it is thought that it is useful to plan various environmental education programs.

Ethic

Ethical committee approval was received from the Tokat Gaziosmanpaşa University-Social Sciences and Humanities ethics committee (Date: 10.07.2020, No: 01-14).

Author Contributions

This article was written with the joint contributions of three authors.

Conflict of Interest

The authors declare that they have no conflict of interest.

Notes

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Does School Counselors' Self-efficacy to Work with Gifted Students Fed by Their Knowledge and Perception regarding Giftedness

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Abstract

The unique characteristics constituting giftedness make gifted students quite different from other same age peers and differieniate their psychological needs. School counselors have critical roles in providing effective and emotional assistance to those gifted students. School counselors' self-efficacy is an important factor in serving both gifted students and non-gifted students. Thus, the current cross-sectional study aimed to examine whether school counselors' knowledge and perceptions of the gifted students predict counselors' self-efficacy to work with this specific group after controlling for work experience. The sample comprised 118 Turkish psychological counselors actively engaged in psychological counseling practices in school settings in Elazığ, Turkey. As data collection tools, School Counselors' Knowledge, Perception, and Self-Efficacy Scales regarding gifted students, and a demographic form were used. Hierarchical regression analysis was applied to examine predictive associations. Results demonsrated that counselors' work experience, knowledge, and perceptions regarding gifted students were found as significant predictors and explained the 44% of the total variance in their self-efficacy to work with gifted students. By increasing self-efficacy levels of school counselors to work with gifted students and possibility of better counseling and assistance, the current study showed the importance of enhanced knowledge and perceptions towards gifted students.

Key Words

Counselor' knowledge • Counselor' perception • Gifted students • School counselor' self-efficacy

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Introduction

Although researchers do not agree on the definition of giftedness due to the complex nature of the phenomenon, but they agree on the notion that gifted students are different than their chronological peers in terms of cognitive, emotional, psychological, and developmental traits. Cognitive characteristics of gifted students include logical thinking ability (Frasier & Passow, 1994), persistent concentration (Root-Bernstein & Root-Bernstein, 2004), superior memory (Plucker & Callahan, 2008), better speed abilities including inspection time, reaction time (Sternberg et al., 2011), divergent thinkers (Ishak & Abu Bakar, 2010) and persistent intellectual curiosity (Delisle & Galbraith, 2002), Additionally, these students are mostly deal with details of words and their usage, learn with less effort, and do not forgat easily (Kregel, 2015). These capabilities aid gifted students in comprehending concepts at an accelerated pace relative to their non-gifted counterparts, facilitating the cultivation of a heightened degree of depth and complexity in their understanding.

Apart from the positive traits mentioned above, they may have some emotional, social, academic and relational difficulties more than other students because of their distinctive characteristics. What mainly make gifted students different from their same age peers and differentiate their psychological needs could be having emotional intensity or hypersensitivity (Mendaglio & Peterson, 2007), perfectionism (Chan, 2007), and asynchronous development (Davis & Rimm, 1994). There has been extensive literature that gifted students are more likely to have perfectionist tendencies than non-gifted peers (Parker & Adkins, 1995; LoCicero & Ashby, 2000; Davis & Rimm, 1994; Schuler, 2002). Therefore, many gifted students consult counseling services to manage unhealthy perfectionism tendency they have. Gifted students also experience situations such as bullying, parental issues, or peer conflict in the same manner as other students do, but with higher level of intensity (Wood, 2006).

Social-emotional concerns of the giftedness (gifted students) examined by various studies and they reported that gifted students may experience depression, anxiety and many other emotional and social concerns than their non-gifted counterparts (Berlin, 2009; Neihart, ; Jackson & Peterson, 2003). Sensitivity, asynchronous development, and overexcitability are also considered risk factors for gifted students (Silverman, 1994). Coleman and Hughes (2009) argued that gifted students have many stressors which produce anxiety. For example, based on others' high expectations they may force themselves to complete their tasks perfectly, but when there is uncertainty of the performance the feeling of the anxiety may arise (Cross & Cross, 2015). On the other hand, there is no research finding indicating that gifted students tend to have a genetic predisposition for emotional-affective concerns than non-gifted students. According to Webb (1994) depression among gifted students may come from misplacement or continual appraisal and disapproval of their performance and criticism. Besides, Kerr and Cohn (2001) argued that gifted students without a meaningful sense of belonging and a guiding friend might experience depression and alienation.

School counselors are going through intense preservice and inservice education process in order to provide assistance and help students in personal/social, academic and career related issues (American School Counselor Association [ASCA], 2013). Based on their education in many domains, they have no privilige to serve only one group of students, as they are responsible providing assistance to the all students. In this respect their position is ideal

to help the gifted students in solving their problems (Roberts et al., 2010). Elijah (2011) identified several school counselors' roles when they work with gifted students. These include the following: (1) assisting and taking active role in identification process; (2) increasing the awareness and understanding issues affecting them; (3) working with stakeholders to enhance educational opportunities; (4) based on their unique needs advocating for programs or activities that address these needs. Gifted students, much like their contemporaneous peers, also seek guidance and support from school counselors. As Wood (2010) examined their the counseling experience with a sample of 153 gifted students. Findings suggested that gifted students found counseling beneficial for them. In a similar vein Abu Bakar and Ishak (2010) carried out a program in Malaysia and they reviewed the counseling form to shed light on the counseling needs of Malaysian gifted students. Their findings showed that 11 students among the 33 gifted students consulted for counseling.

Studies have indicated that to effectively serve in the counseling field self-efficacy emerge as an important determinator (Larson & Daniels, 1998) due to influencing ability to form a healty and powerful counseling relationships. The self-efficacy as more general concept has emerged and evolved from Bandura's (1977) work, Social Cognitive Theory. According to this theory, in operating specific tasks self-efficacy is a leading factor in motivation and behavior of individuals (Bandura, 1986; Graham & Weiner, 1996). The theory assumes that self-efficacy is not only related to the skills or abilities that a person has but also concerned with judgment about what can one do with what he or she has (Bandura, 1986). In a similar vein, Larson and Daniels (1998) define counselor self-efficacy as "one's beliefs or judgments about her or his capabilities to effectively counsel a client in the near future". Bandura (1995) assumed that person who has a higher self-efficacy also highly motivated, committed, persistent, and resilient in performing his/her roles. In this sense, Bodenhorn et al., (2010) pointed out that contrary to school counselor with lower self-efficacy, with higher self-efficacy school counselors are more beneficials and effective in serving students. However, the conducted studies mostly concentrated on the counseling skills as self-efficacy of this group. Related studies were extensively examined the role of self-efficacy in many domain of the counseling fields (e.g. individual counseling). But, school counselors' self-efficacy in working with gifted seems overlooked and did not piqued researchers' attention to much until now. School counselor self-efficacy is also defined in the context of the school settings as counselors judgements about their capacities to perform counseling tasks in schools (Holcomb-McCoy et al., 2009).

Counselors' knowledge and perceptions regarding gifted students are two factors that influence school counselors' self-efficacy in serving gifted students. In gifted education literature, there is not an empirical research study focused the role of knowledge and perception regarding gifted students on school counselors' self-efficacy to serve this population. School counselors who do not have sufficient and enough knowledge about the unique and special needs of gifted students could not serve this population effectively. In the present study counselors' knowledge of gifted students means that familiarity with historical overview of education of the gifted students, from more general information and knowledge to emergence of the specific counseling needs in this area which may affect their involvement (Carlson, 2004). On the other hand, school counselors' gifted students related perceptions means that feelings, beliefs, attitudes, and misconceptions that may play a powerfull role in school counselors' involvement. These perceptions include school counselor' roles and issues and concerns of gifted students (Carlson, 2004).

Although there is increasing movements in the studies of gifted students in Turkey, the self-efficacy of the counselors, their knowledge, and perceptions of the gifted students are ignored and overlook by researchers. When the literature is reviewed only one dissertation has been found regarding counselors' perceptions regarding gifted students in Turkey. In this study Altun (2015) examined counselors' involvement in gifted students' activities. She discovered that the perception held by counselors regarding gifted students constitutes a substantial predictive factor in their interactions and interventions with gifted students. In this sense, our aim is to help in filling the gap in gifted education literature in Turkey by examining the predictive links of counselors' knowledge and perceptions of the gifted students on school counselor self-efficacy to working with gifted students after controlling for their work experience.

Research Questions and Hypothesis

* Is there any relationship between school counselors' knowledge and perceptions of gifted students with their self-efficacy to work with this group?

*How well does school counselors' work experience predict their self-efficacy to work with gifted students?

*How well does school counselors' knowledge and perceptions of gifted students predict their self-efficacy to work with this group after controlling for the effect of work experience?

We hypothesized that school counselors with higher and more knowledge and positive perceptions of the gifted students will have higher self-efficacy to effectively work with this group. Thus, counselors' knoweledge and perception would be positively associated with counselors' self-efficacy. Moreover, work experience of the school counselor will significantly predict counselors' self-efficacy in working with gifted students.

Method

Design

The present study was conducted by utilizing a correlational research design. Correlational research enables to determine the feature of the relationship between two or more variables. It delineates the degree to which two or more quantitative variables are correlated and correlational research is beneficial to draw the prediction for an outcome variable (Fraenkel et al., 2012). The predictor variable that is utilized to draw the prediction; the variable about which the prediction is made is named the criterion variable. In this research, the predictor variables are counselors' experience, counselors' knowledge, and perceptions related to the gifted students, and counselors' self-efficacy is the criterion variable.

Sampling and Participants

School counselors who work in Elazığ comprised of the population of the present study. Convenience sampling was chosen to participate the study because they were individuals who were the reachable groups (Fraenkel et al., 2012). Although convenience sampling may reduce the generalizability of the research, in this case, it was an useful method for sampling since it partially depicts the whole population. In this context, 61 schools were selected as a reachable population for this research as gifted students continue those schools. School counselors serving in chosen

schools constituted sample of the study. It was seen that two or three school counselors were assigned in some schools due to school size. All the school counselors serving in selected schools were involved in the study. The number participants of the present study comprised of 118 school counselors who serve in Elazığ. Participants' descriptive statistics are shown in Table 1 below:

Table 1.

Descriptive Characteristics of Participants

	F	*%*
Work Experience		
1-5	20	16.9
5-10	59	50
10-15	9	7.6
15-20	20	16.9
20 +	10	8.5
Education Level		
Undergraduate	107	90.7
Master	10	8.5
Doctorate	1	.08

Procedure

In order to collect data of the current study institutional and ethical approval from the Human Subjects Ethics Committee was taken. For controlling the data collector bias one data collector was kept constant during the process of data collection. The eligibility criteria for this study was that there is at least one diagnosed gifted student in the school where school counselors work. After obtaining the list of the schools that gifted students attend by contacting the directory of the Elazığ Science and Art Center, school counselors who serve in selected schools ranging from elementary, middle to high schools in Elazığ. The aim of the research was explained to the school counselors whose schools have diagnosed at least one gifted student. Upon obtaining informed consent from participants and providing them with the requisite information pertaining to the research, including an overview of the study's limitations and potential benefits, counselors were requested to fulfill an extensive 84-item survey. Completing the survey was changed between five to fifteen minutes by participants.

Research Instruments

School Counselors' Knowledge Scale. The scale was developed to assess school counselors' knowledge related to the gifted students (Carlson, 2004). It consisted of two subscales which are general knowledge about gifted students and identification knowledge. Participants were demanded to assess their knowledge regarding gifted students utilizing a five-point likert scale from very knowledgeable to not knowledgeable. Higher scores obtained from the scale indicate that school counselors are highly knowledgeable about gifted students. Turkish adaptation of the scale was conducted by Altun (2015). After validity and reliability studies, Altun (2015) reported the internal consistency coefficients as .98 for general knowledge and .93 for identification knowledge. Internal consistency coefficients were found to a .88 for the current study.

School Counselor Perception. The school counselor perception scale was utilized to evaluate counselors' perceptions regarding gifted students (Carlson, 2004). The scale contains 26 positive (I enjoy counseling gifted students) and negative perceptions (meeting the needs of gifted students generate an elite) about gifted students and asks participants to evaluate their perceptions related to gifted students utilizing a Likert scale (1= strongly disagree, 5=strongly agree). 7, 10, and 11 items of scale are reversed-scored items. The original form of scale was composed of nine dimensions. Turkish adaptation of the scale was carried out by Altun (2015). After validity and reliability studies, Altun (2015) reported that the scale consisted of three dimensions and the internal consistency coefficients as .75 for social and academic risks for gifted students, .64 for the unique characteristics of gifted students, and .72 for counseling gifted students. An internal consistency coefficient was determined as .85.

School Counselor's Self-efficacy regarding Special Education. The School Counselors' Self-Efficacy Scale concerning Special Education was designed to assess the School Counselors' Self-Efficacy Scale concerning Special Education (SCSSSE) (Aksoy & Diken, 2009). Scale has 40 items on a five-point Likert scale changing from "strongly agree" to "strongly disagree." This scale was specially selected since gifted students are placed under the umbrella of special education in Turkey. Aksoy and Diken (2009) reported that the scale comprised of one dimension and the internal consistency coefficient of the scale was found as .98. An internal consistency coefficient was determined as .89 for the current study.

Demographic form. A demographic sheet was prepared to collect information on gender, work experience, and educational attainment of the participants.

Data Analysis

For reliability of the data collection tools, Cronbach alpha coefficients of them are computed and .70 was taken as a criteria. SPSS 24.0 computer program was used to analyse the obtained data. Descriptive statistic, Pearson Moment Correlation, and Hierarchical Regression Analysis was used for data analysis. Descriptive statistics was utilized to show the characteristics of the participants. Pearson Moment Correlation was employed to examine the relationship among school counselors' knowledge, perceptions, and self-efficacy in serving gifted students. Before performing the hierarchical regression analyses, the assumptions of hierarchical regression analyses were controlled based on criteria recommended by Field (2013). To perform hierarchical multiple regression any categorical variable which has more than two levels requires recoding (Tabachnick & Fidell, 2013). In this study dummy coding employed for this aim. In dummy coding, we select a reference category to compare with other categories. In the present study work experience is a categorical predictor variable with three levels (1-5 years' experience, 5-10 years' experience, and 10 and more years' experience), thus, dummy coding was used by taking 1-5 years' experience group as a reference category. The first dummy variable compare 5-10 years' experience group with 1-5 years' experience group and second one compare 10 and more years' experience group again with 1-5 years' experience group. Dummy variables were named as work experience_D1 and work experience _D2 respectively. Hierarchical Regression was utilized in order to examine the predictive relationship among work school counselors' work experience, knowledge, perceptions, and self-efficacy.

Results

Before performing Hierarchical regression analysis, related assumptions of the hierarchical regression were checked. First, descriptive statistics for predictor and outcome variables were controlled. The mean and standard deviation for predictor variables and outcome variable was presented in table 2 below:

Table 2.

Descriptive Statistics of the Variables

Variables	*M*	*SD*
Counselors' Self-efficacy	144.69	27.65
Counselors' Knowledge	77.59	19.78
Counselors' Perception	57.90	8.9

In order to evaluate the normality of residuals, an examination of both the histogram and the Probability-Probability (P-P) plot was conducted, revealing an approximate adherence to the normal distribution, thereby affirming the fulfillment of this assumption (Field, 2013). For controlling the assumption of the interdependence of errors, Durbin Watson statistic was employed. The value should fall between 1.5 and 2.5 so as not to violate the assumption (Tabachnick & Fidell, 2007). For the current study, Durbin Watson value was found as 1.86 showing no violation of the assumption. For the homoscedasticity assumption, the scatter plots of the regression were checked. no apparent pattern was found as evidence of homoscedasticity in the scatter plot (Field, 2013), therefore homoscedasticity assumption was satisfied. Tolerance and VIF values also were controlled. Since all of the tolerance values were higher than .20 and all of the VIF values were smaller than 4, the multicollinearity assumption was fulfilled (Tabachnick & Fidell, 2013). The correlation between outcome variables and predictor variables was checked. The result of the correlation is shown in table 3 below:

Table 3.

Bivariate Correlations of the Study Variables (N=118)

Variable	1	2	3	4	5
1. Counselor' Self-efficacy	1				
2.Work Experience D1	-.04	1			
3.Work Experience D2	-.16	-.70**	1		
4.Counselor' Knowledge	.60**	-.23	-.11	1	
5. Counselor' Perception	57**	.16	.-17	.56**	1

Note. ** *p*<0.01 level (two-tailed).

As presented in Table 3 criterion variable (School counselors' Self-efficacy) significantly and positively correlated with counselors' knowledge ($r = 60$, $p <.01$) and perceptions regarding gifted students ($r = 57$, $p <.01$). For the main research question, hierarchical regression analysis was carried out to investigate how well counselors' work experience, knowledge, and perceptions concerning gifted students predicted counselors' self-efficacy to work with them. In the present study, work experience of school counselors (D1 and D2) were put into the analysis as model 1

predictors. Counselors' knowledge and perceptions regarding gifted students were entered into the analysis in the second model predictors. The results of hierarchical regression analysis are shown in Table 4 below:

Table 4.

Results of Hierarchical Regression Analysis

Variable	B	SE B	β	T	sr^2	Δ R²	ΔF
Model 1						.07	4.48*
Work Experience D1(1-5 vs. 5-10)	-.16.6	6.95	-.30	-.2.39	.05*		
Work Experience D2 (1-5 vs. 10+)	-.21.9	7.39	-.37	-.2.96	.07*		
Model 2						.37	22.52*
Knowledge of Gifted	.50	.15	.36	3.45	.06*		
Perception of Gifted	1.11	.29	.36	3.82	.07*		

According to the findings, the Model 1 was significant *F (2, 117)* =4.48, *p*=.01 and explained *7%* of variance in counselor self-efficacy of working with gifted students. As presented from the table both Work Experience_D1 group (5-10 years' experience group vs. 1-5 years' experience group) (*β* = -.30, *t* = -2.39, *p*=.02) and Work Experience_D2 group (5-10 years' experience group vs. 10+ years' experience group) (*β* =-.37, *t* =-2.96, *p*=.00) significantly predict the variance in counselor self-efficacy of working with gifted students. According to the these results counselors having 1-5 years of experience had higher self-efficacy of working with gifted students than counselor having 5-10 years of experience. Similarly, counselors having 1-5 years of experience had higher self-efficacy of working with gifted students than counselor having 10 or more years of experience. In the first model Work Experience_D2 group_D2 (1-5 vs. 10+) was strongest predictor and uniquely explained *7%* of variance of counselors' self-efficacy regarding gifted students.

In model 2, counselors' knowledge and perceptions regarding gifted students variables were entered the model as independent variables. Model 2 was also significant *F(4, 117)* = 37.71 *p*=.000 and explained *44%* of variance in the counselors' self-efficacy of working with gifted students. This means that after controlling the effect of variables in first model, second model explained *37%* of variance in counselors' self-efficacy regarding gifted students, $ΔR^2$ =.37, *ΔF* (2, 117) = 22.52, *p* =00. As presented at the table counselors' knowledge regarding gifted students (*β*=.36, *t*=3.45, *p*=.00) and their perceptions regarding gifted students (*β*=.36, *t*=3.82, *p*=.00) predicted school counselors' self-efficacy of working with gifted students significantly. Although counselors' perceptions regarding gifted students explained slightly more (7%) variance than counselors' knowledge regarding gifted students, both variables are important factors and determinators in increasing the counselors' self-efficacy level of working with gifted students.

Discussion

As the needs of children and adolescents alter, it is crucial for school counselors to appropriately address psycho-emotional needs of all students. Thus, school counselors play critical roles in career and college planning and

providing assistance with the social and emotional concerns of gifted students. Although gifted students are not very different from their peers and experiencing and going through all of the crises and concerns others have, but there are several concerns unique to gifted students that are identified for them as counseling needs (Kerr, 2021). These counseling needs differentiate them from their peers, though basic counseling interventions are also needed for them. As stressed, gifted students ,based on the their unique charecteristics, have quite different psychological needs than their same age peers (Chan, 2007; Davis & Rimm, 1994; Mendaglio & Peterson, 2007). They are more prone and tend to experience anxiety, depression, and loneliness than their non-gifted counterparts (Berlin, 2009; Jackson & Peterson, 2003; Neihart, 1999). For instance, Wood (2010) ascertained that gifted students encounter counseling challenges such as the apprehension of failure, perfectionism, and issues related to social acceptance. Colangelo (2002) emphasized the paramount significance of possessing the requisite knowledge and expertise as essential factors for achieving success in the role of a school counselor when assisting gifted students. Though gifted students related studies has been raising both in Turkey and at globe, but there is limited studies about counselors' self-efficacy, knowledge, and perceptions regarding gifted students. For this reason, the present study aimed to examine the roles of school counselors' knowledge and perceptions of the gifted students in predicting their self-efficacy of working with this specific group after controlling for their working experience.

Firstly, our findings revealed a significant and predictive link between the work experience of counselors and their self-efficacy in serving gifted students. More specifically, the unique contribution of counselors with 0-5 years of work experience group were significantly greater than counselors with the 5-10 year of experience group and 10-more year of experience group in counselors' self-efficacy. This finding confirmed by a previous research in which novice counselors sensed confident in meeting the counseling needs of gifted students (Edwin & Fisher, 2023). Nice et al. (2020) also indicated that school counselors feel confident in dealing with students' challenges after starting to work with students, without lacking more experience. It may be speculated that novice counselors were more eager than senior counselors to serve gifted students. This result may also be explained by counselor preparation programs. Experienced school counselors may feel inadequate in providing counseling to gifted students because they may not receive adequate in-service training or supervision regarding this group.

A great deal number of studies investigated construct of counselors' self-efficacy in the literatüre (Bandura, 1986; Daniels & Larson, 2001; Halverson et al., 2006). However, counselors' self efficacy in relation to their knowledge and perception about gifted students has been under-researched. According to the findings of the current study counselors' knowledge and perception related gifted students heightened their self-efficacy to work with this specific group. These results were consistent with the findings of previous studies which investigated the role of school counselors' perceptions and knowledge about gifted students in supporting them (Carlson, 2004; Kennedy & Farley, 2018; Peres, 2013) and involvement in gifted students' activities and in working with them (Altun, 2015). As the school counselors enhance their knowledge and perceptions towards gifted students, self-efficacy of them escalates in serving and produces positive results , as when compared with counselors with lover self-efficacy, who has higher self-efficacy serve more effectively (Bodenhorn et al., 2010). In gifted students' context as our findings revealed, self-efficacy of the school counselors fed by their knowledge and positive perceptions regarding this group. Our findings also provided evidence for that increased knowledge and positive perceptions about gifted students would

increase the possibility of better counseling and assistance (Colangelo, 2002; Davis & Rimm, 1998) and meeting their unique needs (Kennedy & Farley, 2018).

Gifted students with unique cognitive and social-affective attributes have counseling needs that are distinctive from other same age counterparts. If the proper counseling service is not provided, they may face many challenging problems and might not be able to actualize their innate potential (David, 2021). In this context, it is important to take into consideration counselors' knowledge regarding gifted students as a differentiated and tailored to the needs of gifted students. Previous research suggested that school counselors should provide an effective counseling services for the gifted students (Wood, 2010; Jie & Hassan, 2019). As our findings confirmed, this task can be achieved through the increased knowledge and positive perceptions that counselors possess about gifted students and explore gifted students' unique counseling concerns and develop effective interventions, raising their self-efficacy (Edwin & Fisher, 2023). In other word, in order to serve better to the gifted students, school counselors must have the knowledge on the unique characteristics of gifted students as well as interventions tailored to this group. School counselors with more knowledgeable of the gifted students' needs and socio-emotional lives may provide more beneficial counseling services to them in promoting their well-being and healthy development.

An implication for practice would be for school counselors who work in school settings may increase their knowledge and positive perceptions via attending in-service training. When training programs of school counselors are examined, unfortunately, the needs of gifted students are ignored, underscored and generally are not included as an area of competence (Evans, 1997). In a similar vein Ozcan and Uzunboylu's (2020) study with a 52 school counselors working in the primary school indicated that school counselors did not equip with necessary knowledge regarding the personal, academic and social challenges gifted students experience as well as appropriate interventions targeted them. For this reason gifted students related courses should be included to the training programs of school counselor as our findings underline the importance of knowledge and perception regarding gifted students in predicting their self-efficacy to work with this specific group. It can be possible for school counseling students to take a certain amount of required direct counseling courses regarding gifted students. This experience may help them to gain competencies in working with gifted students. Hence, involvement in courses or conferences about gifted students and their unique social-emotional needs may contribute to school counselors' self-efficacy.

In this context, it is imperative to acknowledge that our findings are subject to certain limitations. The current study, indeed, exhibits several constraints that bear implications for both the validity and generalizability of the obtained results. First of all, participants' knowledge, perceptions, and self-efficacy were evaluated by self-report method. Some participants want to be perceived as more knowledgeable than they were and this causes response bias which influences the validity of the study. The data were gathered from the school counselors working in Elazığ, Turkey via convenient sampling. Therefore, the generalizability of the results is limited to school counselors who work in Elazığ. In addition the data of study was cross-sectional and our analyses were correlational in nature. Thus, results cannot be interpreted in the context of causality. Our findings should be reexamined with larger diverse populations both in Turkey and globally by conducting empirical and longitudinal studies with different analyses which pay the way for directionality and causality. Lastly, mixed method studies can be conducted to rich

understanding of the pheromone. Apart from these limitations we believe that our study has significance in terms of research, theory, and practice. Counselors' self-efficacy, knowledge, and perceptions regarding gifted students are rare and generally investigated in the USA. Therefore, the findings from this study will contribute to the existent gifted education and counseling literature. To date, no empirical study has been carried out to explore the relationship between school counselors' knowledge, perception, and self-efficacy. These variables will assist school counselors in better understanding the constructs of school counselors' knowledge, perceptions, and self-efficacy regarding the gifted student population. This study has implications for pre-service and in-service training in counselor education. Thus, our findings would be a dataset for further research in this area.

School counselors are key personals for talent development and well-being of gifted students. To better meet the psycho-social needs of the gifted students, school counselors need to have a high level of self-efficacy. At the same time, school counselor should increase their knowledge and develop positive perception regarding gifted students. This increased knowledge and positive perception toward gifted students directly influence counselors' self-efficacy in serving this population. Further research should investigate counselors' gender, socio-economical level, gifted students' attitudes toward school counselors which impact the self-efficacy of school counselors in assisting them.

Ethic

Ethical permission was granted from the institutional review board of Middle East Technical University Social and Human Sciences Ethics Committee (Protocol Number: 2022-EGT--091).

Author Contributions

The authors contributed at all stages, including planning, conducting and writing.

Conflict of Interest

There is no conflict of interest in this study.

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Frequency Analysis of the Top Ten Significant Words Derived with the Suffix -keit in the DeReKo: A Corpus-Based Study in the Context of German as a Foreign Language

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Abstract

The ability to know the rules of word formation in a language and to use these rules in the process of understanding and producing more complex words is part of language skills. In German, it is possible to derive words of different types and with various meanings with morphemes with suffixes such as -keit, -ung, -ig, -lich. In this study, mixed research method was used in which both quantitative and qualitative data collection methods were used together. The study aimed to answer the following questions: What are the top ten most frequent words derived with the morpheme -keit in the DeReKo corpus? What are the significant conclusions from the data obtained from the frequency analysis of the DeReKo corpus? What is the importance of frequency analysis in the context of German as a Foreign Language? What is the importance of corpus-based studies in the context of German as a Foreign Language? In this study, first of all, the frequency of words derived with the statistically significant morpheme -keit was investigated through frequency analysis in the DeReKo corpus. According to the results of the frequency analysis in DeReKo, the top ten words with the highest frequency are "Möglichkeit, Möglichkeiten, Öffentlichkeit, Tätigkeit, Schwierigkeiten, Aufmerksamkeit, Wirklichkeit, Unabhängigkeit, Fähigkeiten and Notwendigkeit". Finally, the importance of corpus-based studies and frequency analysis for GFL is emphasized.

Key Words

Corpus linguistics • DeReKo • Frequency analysis • -keit suffix

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Introduction

Our ever-changing world requires different names and concepts for new events and new situations. For example, with the Covid-19 pandemic affecting the whole world in 2019, all languages have gained new concepts. Vocabulary must be constantly supplemented to adapt to changing situations and meet the requirements of the language. For this reason, new vocabularies are created by combining the morphemes, the smallest meaning-bearing structural unit of a language, according to certain patterns (Horstmann, Settinieri & Freitag, 2020; Meer & Pick, 2019; Meibauer, Demske, Geilfuß-Wolfgang, Ramers, Rothweiler and Steinbach, 2007; Pelz, 1992; Schäfer, 2015; Spillmann, 2000). In the use of such words, the receiver hears part of a word with which he is already familiar and can usually interpret it correctly on first hearing. For German, the words "möglich (possible), öffentlich (public)" are examples of this situation. By adding the morpheme -keit to these adjectives, new words and new word types "Möglichkeit (possibility)" and "Öffentlichkeit (public)" can be formed In this way, language learners develop the ability to correctly understand unheard sentences and create their own new sentences characterizing the creative nature of the language. Morphs, on the other hand, are achieved by breaking words into their parts, through morphs new words are formed in a language, new words can be derived by adding to existing words (Meibauer et. al., 2007; Meer & Pick, 2019; Dipper, Klabunde & Mihatsch, 2018; Horstmann et. al., 2020). In the literature, word derivation and word formation are discussed with different concepts in German and in subfields of linguistics such as morphology, semantics, syntax and grammar: Nominalization (Nominalisierung or Substantivierung) (Bussmann, 2002), derivation (Derivation) (Fleischer & Barz, 2012; Pelz, 1990), word formation (Wortbildung) (Hentschel & Weydt, 2003; Hentschel, 2021; Karatas, 2005). At the same time, different morphs can function in different ways, and these morphs are then called allomorphs (Harnisch & Trost, 2009). The suffixes -gil and -ler are examples of this in Turkish: "annemgil/annemler geldi (my parents came)". What is meant in this sentence is that my mum and her entourage have arrived. The Turkish suffix -gil and -ler adds plural meaning to the word to which it is added in Turkish. Depending on the context of the conversation, it can be my mum and my dad or my mum and the people with her (my brother, my aunt, my uncle, my mum's friends etc.). In German, on the other hand, the suffixes -st and -est, which are added as superlative form (Superlativform) suffixes that rank adjectives, function as allomorphs: dunkel ⇒ die dunkl-e Schokolade ⇒ die dunkel-st-e Schokolade (Harnisch & Trost, 2009). In German, there are morphemes like Kopf (head) that have a single meaning and can stand alone, and these are also called lexemes (Spillmann, 2000; Meibauer et. al., 2007; Dipper et. al., 2018; Horstmann et. al., 2020). Those that cannot be used independently and have more grammatical functions are also called grammatical morphemes. In German, Genetiv -s, -es are examples of these morphemes.

When we look at all these concepts, we come across the concepts of word, morpheme, lexical unit and morph. Since a word structure needs a lexical unit core structure and since it is necessary to place this word structure in a lexical unit category, every word must contain at least one root (Stamm) (Schäfer, 2015). In addition, the concept of affix is also used for morphs other than non-root word structures. German has a wide variety of affixes for word formation. Affixes are categorized in three structures. These are prefixes (Präfix), suffixes (Suffix) and separable affixes (Zirkumfix). One of these suffixes is the suffix -keit, which helps to derive nouns from adjectives. The suffix -keit is a variant of the suffix -heit. It comes with the adjectives -ig, -bar, -sam, -lich and is a suffix that helps to

derive nouns from adjectives (Fleischer & Barz, 2012). The suffix -keit is a suffix used with -heit to nounize adjectives in German. Suffixes such as -keit (Fähigkeit (ability)), Abhängigkeit (dependence)), -heit (Schönheit (beauty)), -ung (Begrüßung (greeting), Forschung (research)), prefixes such as ver- (verlaufen (run, proceed)), auf- (aufbereiten (edit, prepare)), her- (herstellen (produce, create)) and prefixes such as ge-...-e (Gerede (talk, gossip)), ge-... -ig (gefügig (compliant)), be-...-ig (begradigen (straighten)), and Zirkumfixes are important within the scope of German as a Foreign Language (Meibauer et. al., 2007; Nacak, 2020; Pelz, 1992; Spillmann, 2000). As can be seen, there are many ways of word derivation. Word derivation has an important place in developing four basic language skills. These four basic language skills are divided into two as receptive and productive skills. In German as a Foreign Language classes, "receptive skills" and "productive skills" i.e. listening and reading comprehension as well as speaking and writing skills are acquired and need to be developed (Funk et al., 2014; Rösler, 2012). Vocabulary knowledge plays an important role in this process. Therefore, most frequent words derived with the suffix -keit were analyzed using corpus linguistic analysis.

Vocabulary knowledge and derivation, the use of different types of words, occurs both orally and in writing in a variety of text types, including everyday texts, e.g. in newspaper or news texts, Wikipedia articles, literary texts, but also in spoken expressions and musical texts (Kabatnik, 2020; Storrer, 2013). In the DeReKo corpus, the largest corpus of the German language, the frequency of words derived with the statistically significant -keit morpheme was investigated through frequency analysis. The top ten words with the highest frequency were identified by the frequency analysis method in DeReKo, respectively. Hence, the importance of corpus-based studies and frequency analysis for GFL[1] lessons is emphasized. In addition, it is thought that this study will set an example for corpus linguistic research on suffixes such as -keit, -ung, -ig, -lich, which are used to derive words of different types and meanings in German.

Purpose and Importance of the Study

The ability to know the rules of word formation in a language and to use these rules in the process of understanding and producing more complex words is part of language skills. In German, it is possible to derive words of different types and with various meanings with morphemes with suffixes such as -keit, -ung, -ig, -lich. The use of these words has an important position for students learning German as a Foreign Language in terms of using them in the text and understanding such words in the text. Word derivation is very important especially in language teaching in terms of analyzing and understanding structures, and in terms of text reception and production. For students who want to improve their vocabulary knowledge, knowing the structures of word derivation from different types of words makes it easier for them in language learning. In other words, knowledge of deriving new words from different types of words is necessary for students in order to improve their vocabulary knowledge. The aim of this study is to identify the top ten most frequent words derived with the -keit morpheme through corpus linguistic analysis and to underscore the significance of corpus-based studies and frequency analysis for the teaching of German as a Foreign Language using these sample words. The questions that were sought and investigated in the research are as follows:

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[1] German as a Foreign Language

- What are the top ten most frequent words derived with the morpheme -keit in the DeReKo corpus?
- What are the significant results according to the frequency analysis of the DeReKo corpus?
- What is the importance of frequency analysis in the context of GFL?
- What is the importance of corpus-based studies in the context of GFL?

Method

Research Design

The research was conducted using corpus linguistic methodology, in which both quantitative and qualitative data were analysed (Hirschmann, 2019; Lemnitzer & Zinsmeister, 2015; Scherer, 2006). This method was preferred because it allows for an in-depth investigation of the topic to be researched (Lüdeling & Kytö, 2009; Schmidt, 2022). In this part of the study, information about the corpus linguistic analysis method, data collection tools and data analysis is given.

Data Collection Tools

In corpus linguistics, the interest is not in individual texts, but rather in the use of language in large groups of texts. This means that corpus linguistics is empirically based and works with quantitative methods (Bubenhofer, 2009; 2018). For this reason, corpus linguistic analysis method was preferred in the study. The DeReKo corpus was preferred as the data collection tool and its features are as follows:

The Corpus Query Processor COSMAS II and the DeReKo[2] Corpus: The DeReKo corpus for the German language, which has existed since 1964, is an electronic archive and corpus of the German written language, maintained and regularly developed by the Institut für Deutsche Sprache, Mannheim (Institute for German Language, Mannheim).

Figure 1

Corpus Query Processor COSMAS II
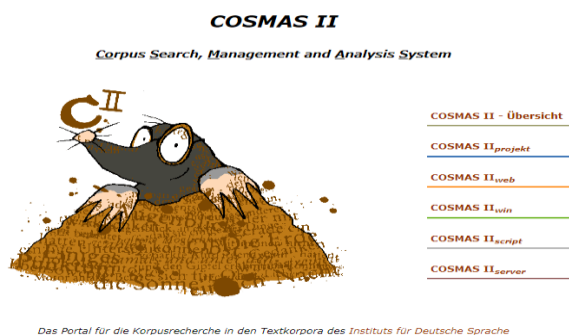
- DeReKo is the world's largest and comprehensive electronic corpus of German current language corpora for linguistic purposes (Kupietz, Belica, Keibel & Wittt, 2010; Kupietz, Lüngen, Kamocki & Witt, 2018).

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[2] Deutsches Referenzkorpus

- The main corpus of German, compiled by the Leibniz Institute for the German Language in Mannheim, consists of written language,

- DeReKo is available to everyone and is the most comprehensive corpus of German,

- It includes many text types (fiction, scientific, popular science texts, newspapers, novels, etc.) and is constantly being developed,

- It is accessible free of charge via the COSMAS II[3] (Corpus Search, Management and Analysis System) platform.

Table 1

Methodology Followed in the Study

Determination of Research Questions and Corpus
DeReKo (W-öffentlich - alle öffentlichen Korpora des Archivs W (mit Neuakquisitionen)
Quantitative and Qualitative Data Analysis
Frequency Analysis / Data Interpretation

Absolute Frequency	Relative Frequency	Frequency Class

The DeReKo reference corpus, which can be accessed through the COSMAS II portal, shows 5 different frequency degrees of words (absolute frequency, relative frequency, probability distribution, difference coefficient and frequency class) (Keibel, Kupietz & Belica, 2008; Keibel & Kupietz 2009). In this study, absolute, relative and frequency class analysis were used as frequency analysis.

Data Analysis

First of all, the archive "W-öffentlich - alle öffentlichen Korpora des Archivs W (mit Neuakquisitionen)", which covers a total of 44,653,080 texts, was chosen for querying the DeReKo reference corpus, which consists of corpora created for many different purposes and from different text types and is collected in 18 different archives in COSMAS II. This archive was chosen because it is the largest of the 18 archives, it contains contemporary texts from the 18th century to the present day, and most importantly, it covers a broad range of text types. Thus, it provided the opportunity to see words formed with the -keit morpheme in different text types. The search query to find words formed with the -keit morpheme in corpora in this archive is "&-keit". In DeReKo, this sign, called the basic form operator or lemmatization operator, queries for new instances of word formation of a word-without-conjugation or word-forming morphemes entered in the "&" search query. With this query, words derived with the -keit morpheme in singular (Möglichkeit (possibility)) or plural (Möglichkeiten (possibilities)) form are found. After this query, the frequency analysis of the words derived with the -keit morpheme was performed and the absolute frequencies were obtained. In the frequency analysis, the words were ranked from the most frequently used word to the least frequently used word according to their absolute frequencies (query setting: nach Häufigkeit absteigend[4]). As a result of the frequency analysis, the 10 most frequently used words were found to be as follows: „Möglichkeit (possibility), Möglichkeiten (possibilities), Öffentlichkeit (the public), Tätigkeit (activity), Schwierigkeiten (difficulties),

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[3] Leibniz-IDS (2023), https://cosmas2.ids-mannheim.de/cosmas2-web/
[4] Decreasing according to frequency

Aufmerksamkeit (attention), Wirklichkeit (reality), Unabhängigkeit (independence), Fähigkeiten (skills) and Notwendigkeit (necessity)"

Results

Statistically Most Frequent Words Derived with the Suffix -keit in German

A frequency analysis was performed on the DeReKo corpus to query the two statistically most frequent words derived with the suffix -keit in German. The results of the analysis are shown in Figure 2:

Figure 2

Results of Word Query with the Morpheme -keit in the DeReKo (W-öffentlich - alle öffentlichen Korpora des Archivs W (mit Neuakquisitionen)) Corpus

As can be seen in Figure 2, the analysis of the DeReKo corpus with the search query "&-keit" yielded a total of 138,339 word forms. The frequency analysis was ordered from the most frequent to the least frequent word in the corpus. According to this result, the most frequent word is "Möglichkeit" with an absolute frequency of 1,306,073 and the second most frequent word is "Möglichkeiten" with an absolute frequency of 859,657. The third most frequently used word in this query is 'Öffentlichkeit' with an absolute frequency of 820,457. These words are followed by other words „Tätigkeit (a.f.[5]=394.918), Schwierigkeiten (a.f.=380.830), Aufmerksamkeit (a.f.=376.

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[5] Absolute frequency

902), Wirklichkeit (a.f.=357.907), Unabhängigkeit (a.f.=226.058), Fähigkeiten (a.f.=224.761), Notwendigkeit (a.f.=203.083)".

The Significant Results According to the Frequency Analysis of the DeReKo Corpus

Table 2 shows the absolute frequency, relative frequency and frequency class results of these two words according to the frequency analysis.

Table 2

Frequency Analysis Results in the DeReKo Corpus

	Möglichkeit (possibility)	Möglichkeiten (possibilities)	Öffentlichkeit (public)	Öffentlichkeiten* (publics)
Absolute Frequency	1.306.073	859.657	820.457	1.015
Relative Frequency (%)	0.020120%		0,007631%	
Frequency Class[6]	8	9	9	18

The most frequently used word is "Möglichkeit" with an absolute frequency of 1,306,073. According to these results, it is remarkable that the second most frequently used word is the plural of the first word. Another striking point is that the word "Öffentlichkeiten" is found 1015 times in this corpus. When the word "Öffentlichkeit" is analyzed, it is observed that "Öffentlichkeiten", which is the plural expression of this word in German language and which is actually incorrectly used in this way, is also present in the corpus. Since the meaning of the word "Öffentlichkeit" is already a plural expression (public, public opinion), the plural of this word is not used in German and can be interpreted as a spelling mistake or an expression error. It is noteworthy here that the word, which is considered incorrect according to German spelling rules, is found in the DeReKo corpus with an absolute frequency value of 1.015. Since the relative frequency value shows the ratio of the investigated word to the words found in the whole corpus, these two words were also analyzed in terms of relative frequency. According to the analysis of the relative frequencies of these two words, it is observed that "Möglichkeit/-en" is a word that is used significantly more than "Öffentlichkeit/-en" (0.007631%) with a ratio of 0.020120%. According to the frequency class analysis, "Möglichkeit" is in 8 frequency classes, "Möglichkeiten and Öffetlichkeit" are in 9 frequency classes, while "Öffentlichkeiten" is in 18 frequency classes. For "Möglichkeit", it can be interpreted that it is used quite frequently according to the frequency class of 8.

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[6] In the Frequency Distribution Class (Häufigkeitsklasse) all words are classified according to their frequency, which is approximately close to each other. There are 30 frequency classes and they are numbered 0,1,2,3,4.... The important thing here is that the smaller the number, the higher the frequency. That is, words in frequency class 0 are the most frequent words, and in German this class includes certain articles (der, die, das, des, dem, den) including their inflections (Keibel, Kupietz & Belica, 2008; Keibel & Kupietz 2009).

Figure 3

Results of the word query[7] Möglichkeit/-en in the DeReKo corpus

Since the word "Möglichkeiten" is the plural form of the word "Möglichkeit", the absolute frequency value of the most frequent word derived with the -keit morpheme is 2,165,730. Figure 3 also shows that this word was found in 996 corpora in 1,737,420 texts between 1997 and 2022.

The Importance of Frequency Analysis and Corpus-Based Studies in the Context of GFL

The words used in texts assembled with the aid of a computer can be compared with the case of the word under investigation or with a specific list of words (e.g. the vocabulary found at the back of textbooks). These words can then be categorised according to the learning level of the students. It is also important that the corpus is large in scope. This facilitates the conceptualisation of linguistic terms. It is important to count the frequency of certain linguistic units and to evaluate this by the frequency of their occurrence in the text (Perkuhn, 2021). Students should try to find unknown words themselves from the context in the text rather than looking them up directly from the dictionary. Here they can benefit from corpora. Corpus linguistics methodology can also support by showing inter-word context, or even inter-word context. In this context, in addition to counting word frequencies, collocations are also important and have an important place (Clarke & Nation, 1980; Mukherjee, 2002). According to the didactic methodological principles developed by Baumert (2016), it makes sense to first start with vocabulary teaching

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[7] Search Query: Möglichkeit*, 2 aktivierte von 796 Wortformen, nach Häufigkeit absteigend [Possibility*, 2 activated from 796 word forms, decreasing according to frequency]

according to frequency, then determine word groups and their frequencies, and systematically expand word combinations. Finally, it is important to follow the order from easy to difficult, from simple to complex, from known to unknown in vocabulary teaching.

It is important to know frequently used words when learning a foreign language, but in some cases it is also necessary to know and use specific words and expressions. Here, it is not enough to just know the word frequencies and create course materials according to this frequency group; instead, it is necessary to identify collocations, show word groups, create a list of word groups and give examples of their use in the text. Of course, for this, it is first necessary to know and determine the frequency of word usage. In this context, it can be said that word frequency ratings and analyzes have an important place in German as a foreign language.

Discussion, Conclusion & Suggestions

To answer the questions, words derived with the suffix "-keit" in the DeReKo corpus were analyzed. According to the results obtained from the frequency analysis in this corpus, frequent words derived with the suffix -keit were identified. According to the results of the frequency analysis in DeReKo, the first most frequent word is "Möglichkeit" and the second most frequent word is plural form of the same word "Möglichkeiten" (Figure 2 and Table 2). According to this analysis, the other words in the top ten are „Öffentlichkeit (The public), Tätigkeit (Activity), Schwierigkeiten (Difficulties), Aufmerksamkeit (Attention), Wirklichkeit (Reality), Unabhängigkeit (Independence), Fähigkeiten (Skills) and Notwendigkeit (Necessity)" respectively. Based on these results, a number of suggestions are made, emphasizing the importance of corpus-driven research, corpora and corpus linguistic analysis (e.g. frequency analysis) for German as a Foreign Language.

- Top ten most frequent words derived with the suffix -keit have been selected for further investigation of their use in context due to their frequency in German, as an example for further research on derivation.

- These results can be investigated in different corpora and a comparison can be made as to whether the results match or not. For example, in the Falko corpus, which is an error analysis annotated corpus, the most frequent word derived with the suffix -keit by learners of German can be investigated. And what kind of errors they make as a result of word derivation can be determined.

- In general, through corpus linguistic analysis, the frequency of constructions derived with the suffix -keit in German shows its importance for German learners. By automatically identifying statistically significant structures, word derivation forms can be adapted to the concept of German textbooks.

- Word derivation, which plays an important role in both receptive and productive skills, should not be limited to linguistics, morphology, semantics and syntax, but should also be addressed in detail in textbooks.

- After data collection and analysis of the selected sample words, corpus data can be used for preliminary evaluations and analysis with texts for the lesson.

- It is thought that it would be useful to add lexicology and corpus linguistics lessons to the current curriculum as a main lesson or elective lesson.

Ethic

I declare that the research was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Author Contributions

All of the authors contributed equally in the article.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Gender in Preschool Education According to Pre-Service Teacher

Aysun Bay Dönertaş[1]

Milli Eğitim Bakanlığı

Abstract

In this study, the issue of gender in pre-school education was focused on the views of pre-service teachers. The study was designed as a phenomenological research which is one of the qualitative research approaches. The study group of the research consists of 39 pre-service teachers studying in the Preschool Teaching Programme at a university in Turkey. In the study, a semi-structured interview form developed by the researcher was used as a data collection tool, and the data obtained were analysed by content analysis. According to the findings, all of the pre-service teachers highlighted that they found gender elements in the behaviours of children and teachers. In their definitions of gender, the participants used the expressions of imposing roles, expectations, behaviors, values, norms on people, and putting people in unnatural molds to behave in accordance with their sex. Pre-service teachers stated that they observed gender elements in preschool children's preferences, peer relations and role behaviours. It was concluded that teachers use gender stereotypes while managing children's behaviours, giving instructions, reinforcing children and communicating with them, directing children to activities according to their gender, and distributing tasks/roles. Pre-service teachers made suggestions for social change/transformation, teachers, regulations in the education system and families to eliminate gender stereotypes.

Key Words

Gender • Preschool education • Preschool teacher

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Concepts

From the first years of life, individuals endeavour to understand and make sense of the environment they live in and themselves. It is possible to say that in addition to gender, questioning about gender roles and expectations are also included in this effort to understand and make sense of themselves. In other words, individuals live experiences that can be associated with the concepts of sex and gender. Although they are often used synonymously, the concepts of sex and gender are two different concepts. The differentiation between the constructs of sex and gender has been a subject of discourse spanning from historical antecedents to contemporary times, encompassing deliberations on the definition, appropriate utilization, as well as the disparities and correspondences inherent in these two concepts (Aslanpay-Özdemir, 2022).

According to Lindsey (2016), the concepts of 'sex' and 'gender' are distinguished from each other in terms of physical, biological, socio-cultural and psychological characteristics. Sex refers to the biological characteristics that distinguish people from each other. This definition emphasises being 'male' and 'female' in chromosomes, anatomy, hormones, reproductive systems and other physiological differences. She adds, gender refers to social, cultural and psychological characteristics linked to individuals through specific social contexts. While sex is the state of being 'male' or 'female', gender categorises people as 'masculine' or 'feminine'. Sex is a status attributed to a person because the person is born with it, but gender is a status that is acquired later due to its learnt characteristic. Similarly Akkaya (2023b) points out that the transformation of 'male' or 'female' persons revealed by the concept of gender into 'masculine' or 'feminine' persons in accordance with the society they live in and the culture dominant in that society is related to the concept of 'gender'. In brief gender refers to the categorisation of women and men in a socio-cultural context and the attribution of roles deemed appropriate to these classes.

Gender is a categorisation that refers to the differences between the sexes defined by existing genetic, physiological and biological characteristics, while gender is a socially constructed, cultural category. Serdaroğlu (2010) underlines that gender refers to common beliefs about what is masculine and what is feminine in different cultures, in different geographies and in different areas in different periods of history, and is defined as the attitudes and behaviours attributed to different genders and the roles and responsibilities to them. According to the author, in this categorisation, masculine traits are generally regarded as ideal and central, while feminine traits are considered marginal and secondary, so this gender-based understanding is established not only at the social level but also at the cognitive level. Gender, which emerges with the social reconstruction of biological sex, transforms into different forms over time from society to society and within the same society (Maybek & Özateş-Gelmez, 2020). It is argued that the acquisition of gender, masculinity and femininity is not 'natural' or purely 'biological', but rather a result of familial and cultural expectations and socialisation. Accordingly, there is a weak relationship between biological sex and social gender. The child learns society's ways of doing, hearing, thinking and discourses on gender and these are reproduced (Günindi-Ersöz, 2016).

In summary, sex is defined as the physiological/biological indicate of being 'female' or 'male', and gender is defined as the state of being 'masculine' or 'feminine' with the characteristics attributed to individuals by society. Elements related to gender may vary from individual to individual, from culture to culture, from society to society, and can be reproduced in society through experiences, belief forms and discourses. It is possible to say that the elements

of gender, which are reproduced by the society, are transmitted from generation to generation in various ways over time, sometimes unchanged and sometimes undergoing changes. Individuals are socialised with gender elements from the moment they are born, and they may be exposed to discourses and behaviours that contain gender elements in the society they live in, or they may become advocates of this understanding.

During the process of socialization, commencing within the familial context and extending into diverse societal settings, children acquire a myriad of knowledge, skills, experiential insights, and role models. Notably, it is during the preschool phase, characterized by rapid developmental growth, that children commence their understanding of the roles of individuals within the societal framework in which they coexist, thereby integrating these insights with their own inherent characteristics as an integral facet of their social development. It would not be wrong to say that the preschool period is a period when children begin to be interested in the differences between males and females. In this process, children begin to learn about gender roles and expectations by receiving messages about the role behaviours of men and women from their environment and the adults around them, from what they see, hear and do. Gender-related elements (colours, messages, icons, symbols, etc.) can be found in books, toys, digital content, clothes, and so forth for children. For example, parents prefer pink/blue items from the moment they learn the sex of the baby, and use analogies such as princess/lion for their babies while they are still in the womb. In addition, it can also be seen that various stereotypes are formed in social life with discourses such as "Women do/don't do ...." or "Men do/don't do ...." and individuals are raised with these stereotypes from childhood.

In addition to all these, teachers' behaviours that contain gender elements can also have an impact on children. Teachers are important actors in this period when children begin to define themselves and discover their gender identity. It is possible to assume that gender roles can be reproduced or prevented by teachers in schools. It is important for teachers to direct classroom practices away from gender stereotypes, in other words, with a critical approach to gender role stereotypes, and to help children develop gender equality in preschool education. In order to create sensitivity about gender starting from the preschool education period, it should be seen as a necessity to develop educational policies on this issue, to address this issue with a correct approach in educational activities and to support teachers' professional development in this field.

When the literature was examined, national (Akkaya, 2023a; Akkaya, 2023b; Aydın, 2023; Bal, 2014; Bingöl, 2014; Daşlı, 2019; Dinçer & Yirmibeşoğlu, 2020; Eroğlu-Şah, 2020; Gümüşoğlu, 2008; Gündüz & Tarhan, 2017; Maccoby, 2000; Moya et al. 2000; Mora, 2005; Taşkın & Nayır, 2021; Sönmez & Dikmenli, 2021; Vatandaş, 2007) and international (Annandale & Clark, 1996; Connell, 2009; Delphy, 1993; Kent & Moss, 1994; Krüger, 2008; Lindsey, 2016; Molla, 2016; Özaydınlık, 2014; Rose & Smith, 2018; Sandnabba & Ahleberg 1999; Torgrimson & Minson, 2005; Wood et al., 2002; Weaver-Hightower, 2003; Yates, 1997) studies are found that focus on gender. Among these studies, there are many studies focusing on preschool education (Alabay & Özdemir, 2020; Bayraktar & Yağan-Güder, 2019; Emeksiz & Bay, 2022; Gürşimşek & Günay, 2005; Karabekmez et al, 2018; Karniol, 2011; Kaynak & Aktaş, 2017; Menekşe & Asan, 2019; Özdemir-Alpan, 2018; Şahin et al., 2016; Trepanier-Street & Romatowski, 1999; Witt, 2000; Yağan-Güder et al., 2017; Yağan-Güder & Güler-Yıldız, 2016).

Revealing gender role stereotypes in the behaviours of children and teachers, who are the subjects of preschool

education, is seen as a valuable issue in terms of research. Based on the fact that it is a necessity to reveal gender role stereotypes in the behaviours of children and preschool teachers and to suggest solutions, the problem of this research is how the concept of gender is in preschool education according to the views of pre-service teachers. This study differs from others in that it reveals gender role stereotypes in the behaviors of both children and preschool teachers in the same study. In this research, according to the views of pre-service teachers; the definitions of the concept of gender, the gender elements in the behaviours of preschool children and teachers, and the suggestions for preventing gender stereotypes are included in a holistic manner. In this respect, it is thought that the research will contribute to the field.

The primary objective of this study is to elucidate the perspectives held by pre-service educators concerning the topic of gender within the domain of preschool education. In alignment with this overarching aim, the investigation will endeavor to address the following inquiries:

1. How do pre-service preschool teachers define the concept of gender?

2. According to the opinions of pre-service preschool teachers, what are the gender role patterns in the behaviours of preschool children?

3. According to the opinions of pre-service preschool teachers, what are the gender role stereotypes in the behaviours of preschool teachers?

4. How can gender stereotypes be prevented according to the views of pre-service preschool teachers?

Method

Research Model

The research was designed as a qualitative study. Qualitative research can be defined as research in which a qualitative process is followed to reveal perceptions and events in a realistic and holistic way in a natural environment by using qualitative information collection methods such as observation, interview and document analysis (Yıldırım & Şimşek, 2021). The study was designed as a phenomenology research, one of the qualitative research approaches. Phenomenology aims to reveal the deeper meaning that people base on their experiences of a phenomenon (Creswell, 2013). In this study, based on the views of pre-service teachers, the concept of gender in preschool education was analysed in depth in a holistic manner and discussed in comparison with the researches.

Working Group

In this study, pre-service teachers' views on gender in preschool education were sought. For this purpose, the opinions of 39 pre-service teachers studying in the preschool teaching programme at a university in Turkey, were obtained. The sample of the study was determined by criterion sampling method, one of the purposeful sampling methods. Reviewing and examining all situations that meet predetermined criteria constitutes the basic logic of criterion sampling. The criteria to be taken as the basis for sampling can be developed by the researcher or a previously prepared list of criteria can be used (Patton, 2002; Yıldırım & Şimşek, 2021).

In this study, the study group was determined by taking into consideration the following criteria: (i) being a student in the preschool teaching programme, (ii) having practice (internship) experience in preschool education classrooms,

(iii) having previously made observations in preschool education classrooms, (iv) having received training on gender in undergraduate course programmes, and (v) volunteering to participate in the study. Accordingly, a study group consisting of volunteer pre-service teachers studying in preschool teaching programme, having observation and practice experiences in preschool education classrooms, and having received training on gender within undergraduate course programmes was formed. The distribution of the participants according to personal variables is indicated in Table 1.

Table 1.

Distribution of participants in the study group according to personal variables

Variable	Categories	N	%
Sex	Female	34	87
	Male	5	13
Age	20-21	14	36
	22-23	21	54
	24 years and old	4	10
Total		**39**	**100**

As seen in Table 1, 34 (87%) of the pre-service teachers participating in the study were female and 5 (13%) were male. It was thought that this distribution was due to the fact that mainly female pre-service teachers were studying in the preschool teaching programme. It is seen that the age range of almost half of the participants (n=21; 54%) is 22-23 years old. The age distribution of the other half of the participants is as follows: 14 (36%) participants aged 20-21, 4 (10%) participants aged 24 and over.

Data Collection and Analysis

In the research, semi-structured interview technique was used to analyse and reveal the views of the participants in depth. The semi-structured interview technique facilitates the researcher in obtaining systematic information in order to continue the interview in a certain direction (Yıldırım & Şimşek, 2021). To accomplish this objective, a semi-structured interview instrument titled the "Gender in Preschool Education Interview Form" was meticulously crafted. The form, in its compositional design, comprises two distinct sections. The initial segment is dedicated to inquiries concerning the demographic attributes of the participants, while the subsequent section is designed to probe into topics encompassing the definition of the concept of gender, the discernment of gender-related components in the behaviors exhibited by both children and educators, as well as soliciting recommendations for mitigating or eradicating gender stereotypes within the preschool educational context. The form was presented to the experts in the field of preschool education[1] and educational administration[2] and the interviews were conducted after making the necessary corrections in line with the expert opinions.

Content analysis method was used to analyse the data. Content analysis aims to reveal the facts hidden in the data (Corbin & Strauss, 1990). Creating a coding scheme in content analysis constitutes the first step of the analysis.

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Qualitative data are classified according to this coding system. This classification creates a framework for organising and defining the data (Patton, 2002). In this context, the views of the participants in the study, which included similar gender elements, were reviewed by the researcher and code schemes were created. In line with these code schemes, according to the meanings derived from the participant opinions, the opinions were organised under certain categories and interpreted together with the opinions of the participants. Participant opinions were re-coded by an expert other than the researcher, and the reliability of the research was determined as %86 with the reliability formula suggested by Miles & Huberman (2021). In addition, the distribution of demographic information of the participants and the frequency of the categories created were calculated with descriptive statistics.

<div align="center">

Findings

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The findings obtained in this study, in which pre-service teachers' views on gender in preschool education were tried to be revealed, were discussed separately under the following headings in the context of the research questions.

Pre-service preschool teachers' views on the definition of the concept of gender

The definitions formed by pre-service preschool teachers about the concept of gender are categorised and presented in Figure 1 together with their frequency distributions.
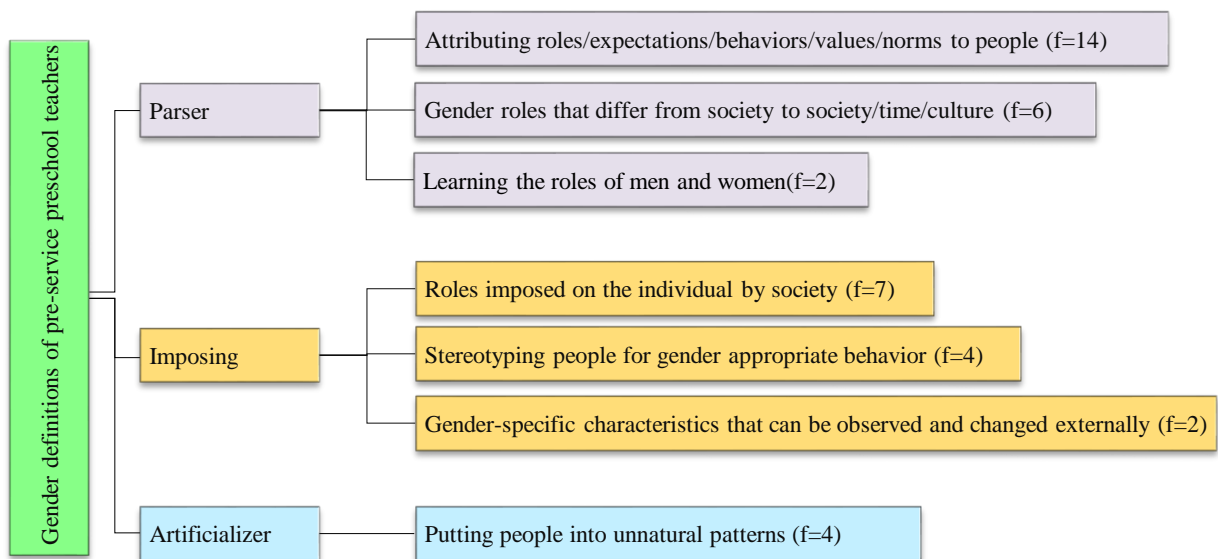
Figure 1. Prospective Teachers' Definitions of Gender

As can be seen in Figure 1, the definitions formed by the participants regarding the concept of gender are divided into three categories: (i) parser, (ii) imposing and (iii) artificializer. When these categories were analysed, it was found that the participants underlined that gender is relatively the most *parser*. Three different views were identified in this category. In the discriminative category, 14 participants defined gender as "Attributing roles/expectations/behaviours/ values/norms on people". The other two definitions in this category are "Gender roles that differ from society to

society/time/culture " (f=6) and "learning the roles of men and women" (f=2). Some of the definitions coded under the parser category are given below.

> *"...Society attributes certain roles to men and women because of their gender. For example, in patriarchal societies, women are generally accused of sitting at home, taking care of children, doing housework, naive, fragile, weak, while men are accused of earning money, superior, head of the house, strong... For example, there is this distinction in terms of colours. Boys like blue, girls like pink..." (T2)*

> *"...Gender is the shaping of femininity or masculinity according to the moulds of society and culture. Of course, these moulds may vary from society to society and from culture to culture. In different countries, in different cities, even in different parts of a city... Time... For example, things that were not considered appropriate for women in the past have become acceptable. Things like working and earning money, studying used to be unacceptable..." (T11)*

> *"...The concept of gender reveals the differences between men and women in terms of social and cultural aspects. Gender and roles are learnt according to the customs, traditions, traditions, customs and norms of the society..." (T6)*

When Figure 1 is analysed, it is seen that the definitions of gender created by 13 participants were coded under the category *of impositionist* under three different views. In the imposing category, the participants mostly (f=7) defined gender as "Roles imposed on a person by society". The other definitions in this category were coded as " Molding people to behave in accordance with their gender " (f=4) and "Gender-specific characteristics that can be observed and changed from the outside" (f=2), respectively. In order to be more explanatory, some definitions created by the participants are given below.

> *"...Society imposes some responsibilities on men and women according to customs and traditions. The responsibilities seen as belonging to the woman and the responsibilities seen as belonging to the man and the responsibilities seen as belonging to the woman are not welcomed by the society. Because society expects men and women to maintain their roles from childhood until the end of their lives. Otherwise, there are reactions. This situation leads to inequality between men and women..." (T27)*

> *"...I can define it as a pattern of behaviours expected from women and men depending on the cultural characteristics of the society and other factors shaping the society. In society, women and men are expected to live in accordance with a certain appearance, communication, behaviour and preferences. For example, women are expected to be gentle, while men are expected to be tough and brave..." (T23)*

> *"...Developing behaviours that people choose themselves or imposed on them from outside depending on their gender... For example, creating their appearance, determining their clothing style according to these patterns... Characteristics that can be observed and changed from the outside... " (T1)*

The last category in Figure 1 is *artificializer* category. The definition made by four participants who highlighted that gender is "putting people into unnatural patterns" was coded in this category. The participant's viewpoint, which

has been categorized under this specific thematic domain and is presented verbatim below, represents a salient and noteworthy statement.

> *"...I can define gender as the moulding and artificialisation of the natural, innate sex. That is to say, there are certain moulds and deconstruction in gender. As time progresses, it undergoes changes. We often hear from our elders: "Oh, these young people today!", "In our time, could girls wear such things?", "And he will be a man! He has grown hair like a woman'. This shows us that values change with the passage of time, in fact, the accepted concept of gender is also changing..." (T18)*

Gender elements that pre-service preschool teachers observe in children's behaviours

Pre-service preschool teachers' views on the gender elements they observed in children's behaviours are categorised and presented in Figure 2 with frequency distributions.
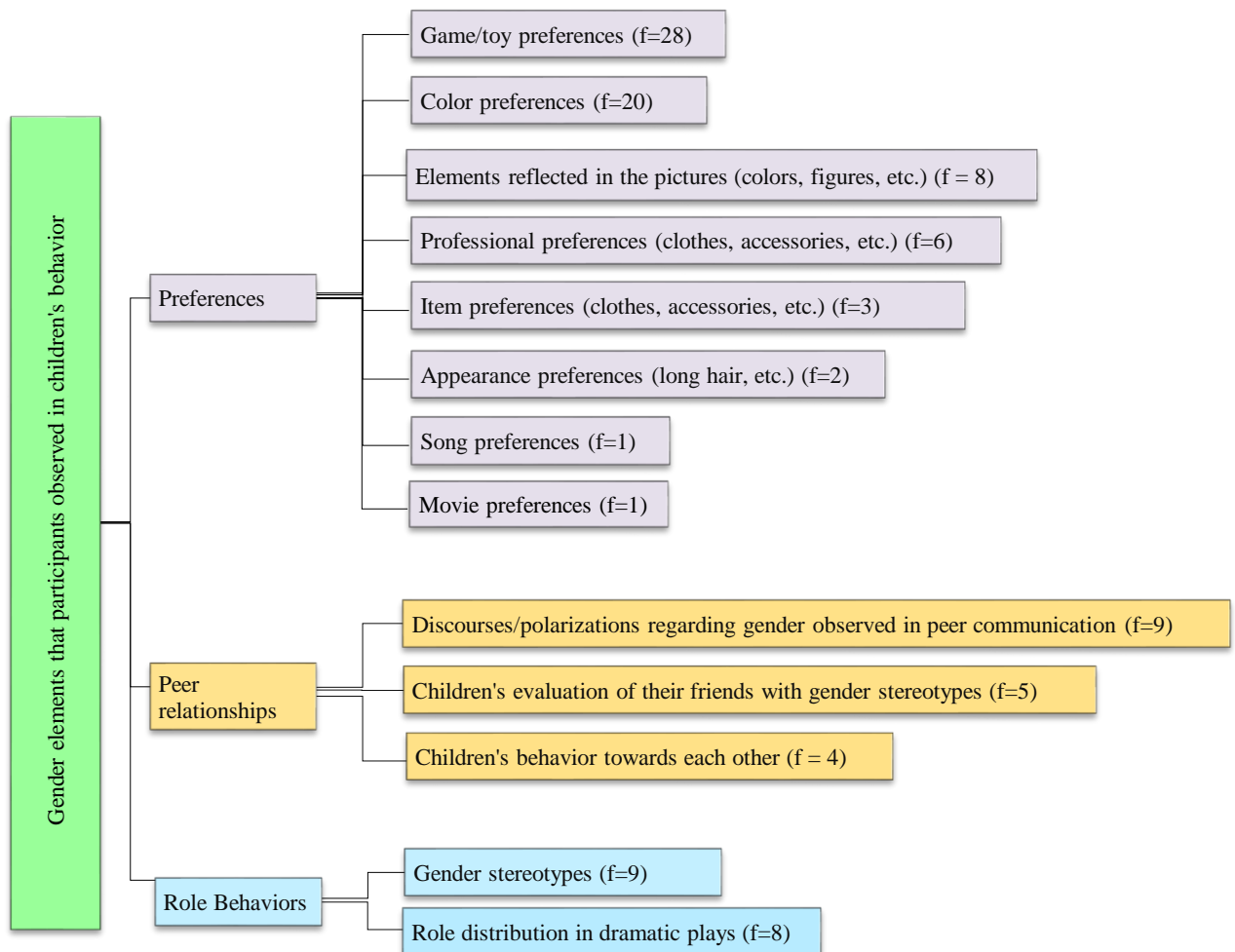
Figure 2. Gender Elements Observed by Participants in Children's Behaviour

When Figure 2 is examined, it is seen that the gender elements that the participants observed in children's behaviours were coded in three different categories: (i) preferences, (ii) peer relations and (iii) role behaviours. The pre-service teachers indicated that they observed gender elements in children's *preferences* the most (f=69). When the eight opinions in this category were examined; the participants stated that they observed gender elements mostly in children's play/toy preferences (f=28) and colour preferences (f=20). In addition, the participants mentioned that they observed gender elements in the elements reflected in children's drawings (f=8), professional preferences (f=6), item preferences (f=3), preferences regarding their appearance (f=2), song (f=1) and film preferences (f=1).

Some of the opinions coded in the preference category regarding the gender elements that the participants observed in children's behaviours are given below.

"...In the classroom where I practice, boys spend most of their time in the block centre and girls in the art and dramatic play centre. The girls usually play with play dough and make cakes out of it, take them to the teacher to have them blown, and mostly use the kitchen set in the dramatic play centre to cook food. Conversations such as 'Look, this is my baby, I'm putting her to sleep, guests are coming in the evening and I'm making a cake' take place in their house playing games. Boys build towers with Legos and blocks, build walls, repair broken items with repair tools, hammer, nails.... 'I'm building a fence for my house', 'My car broke down, I'm repairing it'. They probably respect their fathers, the men around them. Girls also look up to their mothers and the women around them..." (T7)

"...In a school where I went to practice, a child said 'Oh, teacher, are you wearing earrings?' and then said 'Men don't wear earrings'..." (T5)

"...In the drawings made by the children, I observed that boys mostly drew buildings, Turkish flags and cars, while girls mostly drew flowers, houses with gardens and jewellery..." (T9)

"...In the internship I did last semester, while the children were playing in the drama centre, one of the children playing a married couple, the boy said to the girl: 'I am the father, I went to work and you cook at home. I can't help you because I'm going to work. Mums do the cooking anyway". This sentence was actually a sentence that clearly explained their routine at home. At the age of 5, the child saw the order imposed by the society and adapted to it..." (T15)

As seen in Figure 2, pre-service teachers highlighted that they also observed behaviours containing gender elements in children's *peer relationships*. Among the three different opinions coded in this category, the participants point out that they observed discourses/polarisations about gender in peer communication the most (f=9Furthermore, participants conveyed the observation that children tend to assess their peers through the lens of gender stereotypes (f=5) and identified the presence of gender-related components within the interactions and behaviors exhibited by children towards each other (f=4).

Some of the opinions of the participants coded in the category of peer relations regarding the gender elements they observed in children's behaviours are given below.

"...A male student in my class has long hair and sometimes ties it up and sometimes wears it in a bun. Other male students treated this male student obviously differently and went to the extent of exclusion... (T12)

"...In my first implementation class, a few boys were trying to do push-ups/squats while playing. A girl wanted to join them. One of the boys said, "Girls don't do sports!". There are some situations like this that children see, hear and learn from their environment... This is naturally reflected in their conversations and games with their friends. If someone wants to do something different, there are those who warn them to behave in accordance with that mould in group games..." (T30)

"...During playtime, boys generally play with toys such as blocks, cars, repair items and puzzles, while girls generally prefer to play with toys related to housekeeping. When they want to join the boys' game, they say "there are no boys in the game" and do not want to let boys into their games..." (T31)

The last category in Figure 2 regarding the gender elements that the participants observed in children's behaviours is related *to role behaviours*. Accordingly, they stressed that they observed gender stereotypes (f=9) in children's role behaviours. In addition, eight participants underlined that they observed elements of gender stereotypes in children's behaviours in the distribution of roles in dramatic plays (f=8). In order to be more explanatory, some of the participant statements are given below.

"...Again, during a conversation, when I asked a male student what do you do at home and do you help your mum, he said that women do the kitchen work..." (T8)

"...Another example I observed was when we were playing house, one of my male students played the role of father. He came from work, then sat down and asked the girl playing the role of the mother to bring him his dinner. Then he said, 'I am going to the café'. In one part of the play, the girl playing the role of the mother asked the boy to clean the baby's diaper. 'No, I'm the father. Mothers clean the baby's diaper.' He got the answer..." (T24)

"...Another event I observed was when the children were playing in the dramatic play centre during free play time, the girl played the role of mother and the boy played the role of father. One of them had to go to the bakery to buy bread for breakfast. The girl said 'You are the father, you should go to buy bread'..." (T34)

Gender Elements Observed by Pre-service Teachers in Preschool Teachers' Behaviours

The opinions of pre-service teachers about the gender elements they observed in the behaviours of preschool teachers are categorised and presented in Figure 3 with frequency distributions. As seen in Figure 3, the gender elements that the participants observed in teachers' behaviours were grouped under four different categories: (i) address/direction, (ii) choices/presentations, (iii) expectations, and (iv) gender awareness. Among these categories, the category of *addressing/directing was* the category with the most frequent (f=41) opinions, six of which were different from each other. When the opinions coded in this category were examined, the participants mostly (f=14) underlined that they observed gender elements in teachers' behaviours while managing children's behaviours in the classroom. A total of

eight participants noted instances wherein educators guided children towards activities based on their gender and allocated tasks and roles in accordance with gender distinctions. Four participants stressed that they observed gender elements in teachers' behaviours when giving instructions and reinforcing children. Finally, three participants stated that they observed gender elements in teachers' classroom communication with children.
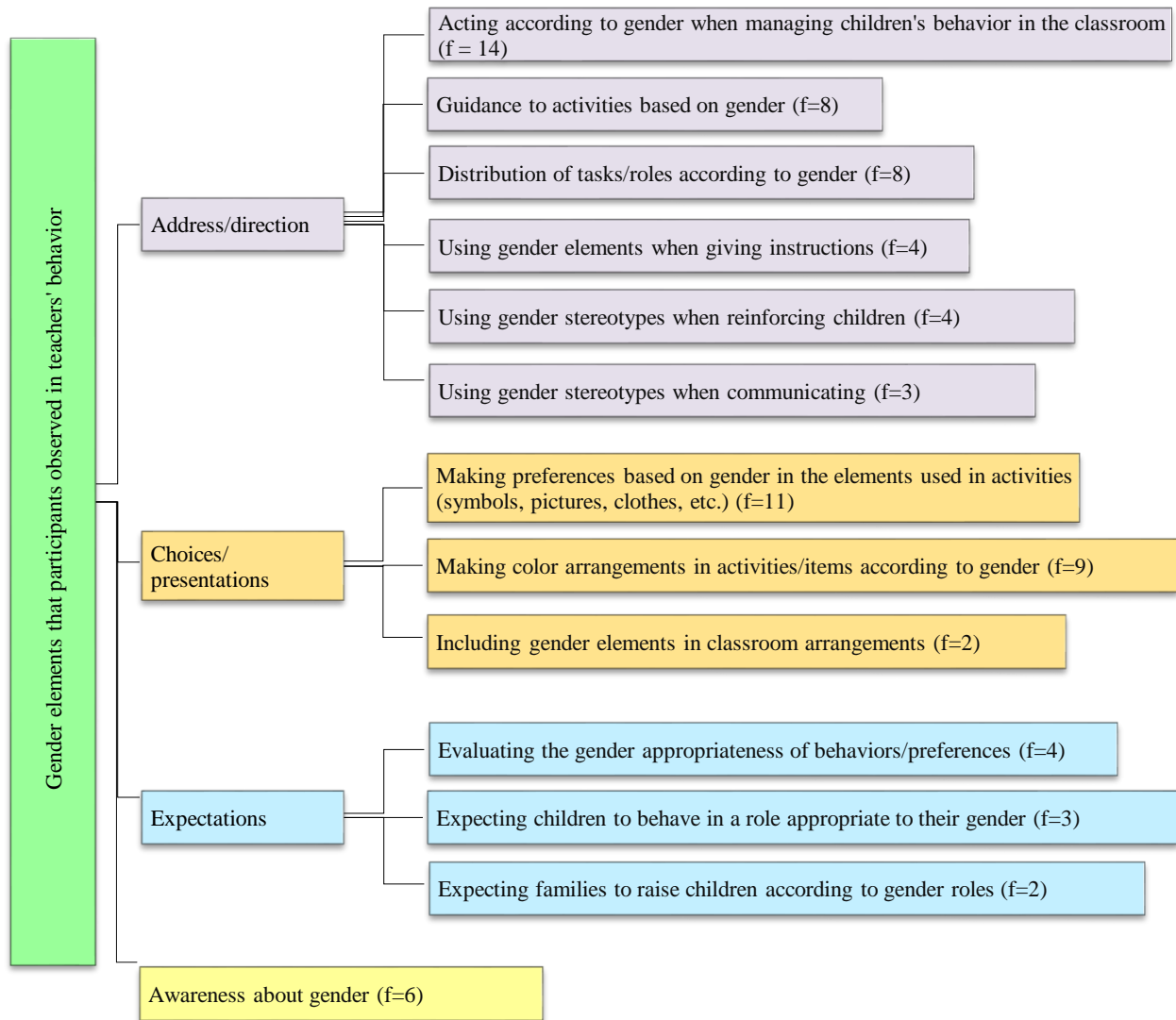
Figure 3. Gender Elements Observed by Participants in Teachers' Behaviour

Some direct quotations from the participants' views in this category are given below.

"...In the classroom, there were disagreements between the boys. One of them stood aside and started crying. While the teacher was trying to solve the problem, she also told him not to cry. She tried to silence him by saying that boys do not cry..." (T20)

"...Children were fighting over toys during free play time. The girls wanted to take the blocks and make houses. The boys wanted to make guns. They needed all the blocks. The children could not agree among

themselves. The teacher said, 'Girls, you paint and boys, you play with cars. No one will play with blocks!'..." (T19)

"...When the children entered the classroom in the morning and left in the evening, the teacher would say things like 'I always wish I had a girl student, I wish my whole class was girls!'. She said that boys were too noisy and naughty. In fact, there were also children in the class who were very quiet, who always raised their fingers and spoke and listened, but the teacher had a negative attitude towards boys. He approached girls more moderately by saying 'My beautiful daughter, my sweet daughter'. She was more distant to boys." (T3)

"...When children queue up as one when going to and coming from the washroom, teachers can direct them as 'Girls go first, then boys go'. For example, they can divide girls and boys into separate groups by giving commands such as 'First girls get dressed, then boys get dressed, first boys get up and drink their water, then girls get up and drink their water'..." (T4)

"...In the 18 March activities, girls were given the roles of nurses and boys were given the roles of soldiers..." (T21)

One of the categories in Figure 3 is related to the *choices/presentations* observed by the participants in teacher behaviours. Consequently, participants underscored their observations of teachers' conduct, which included instances such as exhibiting preferences in the selection of elements employed in activities (e.g., symbols, images, clothing) contingent upon gender (f=11), implementing color schemes in activities and items that were gender-oriented (f=9), and incorporating gender-specific elements within the configuration of classroom arrangements (f=2). For enhanced elucidation, select participant statements are provided below.

"...In one of my practices, I was going to make crowns for the children. The teacher brought green, blue, pink and purple coloured cardboards. She made a distinction according to gender by saying, 'Distribute green and blue to boys, purple and pink to girls'. For example, when working with scissors, boys were given blue scissors and girls pink scissors. In the picture frames in the children's cupboards, the boys' were blue and the girls' were pink..." (T22)

"...she was looking for clothes for the children for the 23 April event. She chose tulle, pink coloured, princess dresses for girls and trousers, shirts and jackets for boys..."(T32)

"...The fact that girls in the dramatic play centre and boys in the block centre were not intervened for a long time, I saw that nothing was done for this in all the internships I went to..." (T26)

"...Our teacher showed pictures such as male mechanic, male greengrocer, female teacher and female cook during vocational activities. Now I think that our teacher actually reflected to the children that professions were chosen according to gender implicitly in all the pictures she showed..." (T37)

According to Figure 3, another category in which the participants coded the gender elements they observed in teachers' behaviours is related to *teacher expectations*. In this category, the participants stated that there were gender

elements in teacher behaviours related to evaluating the appropriateness of behaviours/preferences to gender (f=4), expecting children to perform gender appropriate role behaviours (f=3), and expecting families to raise children according to gender roles (f=2). Some of the direct quotations related to this category are given below.

> *"...One of the things that attracted my attention was that teachers perceived girls who were more active than their friends as more abnormal than boys. Boys can be active, and this is the expectation most of the time. Otherwise, it is assumed that there is something wrong with the child. The fact that girls are more active is not welcomed by teachers and parents. The expectation from girls is that they should always be much more calm and harmonious, ladylike..." (T32)*

> *"...In response to the chasing game of boys, the teacher of the 2-5 age group said, "The boys in this class are always playing active games. They continue the games they see at home here. Whereas girls are calm and play with toys"... (T4)*

> *"...When my mentor teacher had any negative behaviour of the children, she found the blame on the mothers. She stated that it was the mother who raised the child. She said that mothers should take care of the children because fathers were usually busy..." (T13)*

Finally, as can be seen in Figure 3, six participants highlighted that teachers had *awareness about gender*. One of the participant indicated that "*I have not yet encountered such a situation in the preschool institutions I attended. The preschool teachers I worked with were mostly sensitive about this issue. When there was a polarisation between boys and girls in the classroom, for example, when there was a disagreement, they did not ignore this situation. In order to break gender stereotypes, they sometimes gave the colour pink to boys. She sometimes invited boys to girls' games, and in the same way, she invited girls to boys' games. Teachers' approach towards boys and girls was the same*" (T31) is one of the prominent statements in this category.

Pre-service Preschool Teachers' Suggestions for Eliminating Gender Stereotypes

Preservice preschool teachers' suggestions for eliminating gender stereotypes are presented in Figure 4. When Figure 4 is analysed, it is seen that the suggestions developed by pre-service teachers for eliminating gender stereotypes are gathered in four different categories under 20 different opinions. These categories are (i) social change/transformation, (ii) teachers, (iii) arrangements in the education system and (iv) families. As seen in Figure 4, it was observed that the participants suggested solutions for *social change/transformation* to eliminate gender stereotypes. Among the eight different opinions coded in this category, the participants mostly suggested that the awareness of the society on gender should be increased (f=10) and that people should be made aware by using mass media (f=9). Other suggestions in the category of social change/transformation are as follows: organising trainings for adults (f=4), making arrangements in the economic field (f=3), making legal arrangements and applying sanctions (f=3), making arrangements in the public areas (f=2), developing policies based on gender equality (f=2), and shortening the cultural distance between the village and the city (f=1).
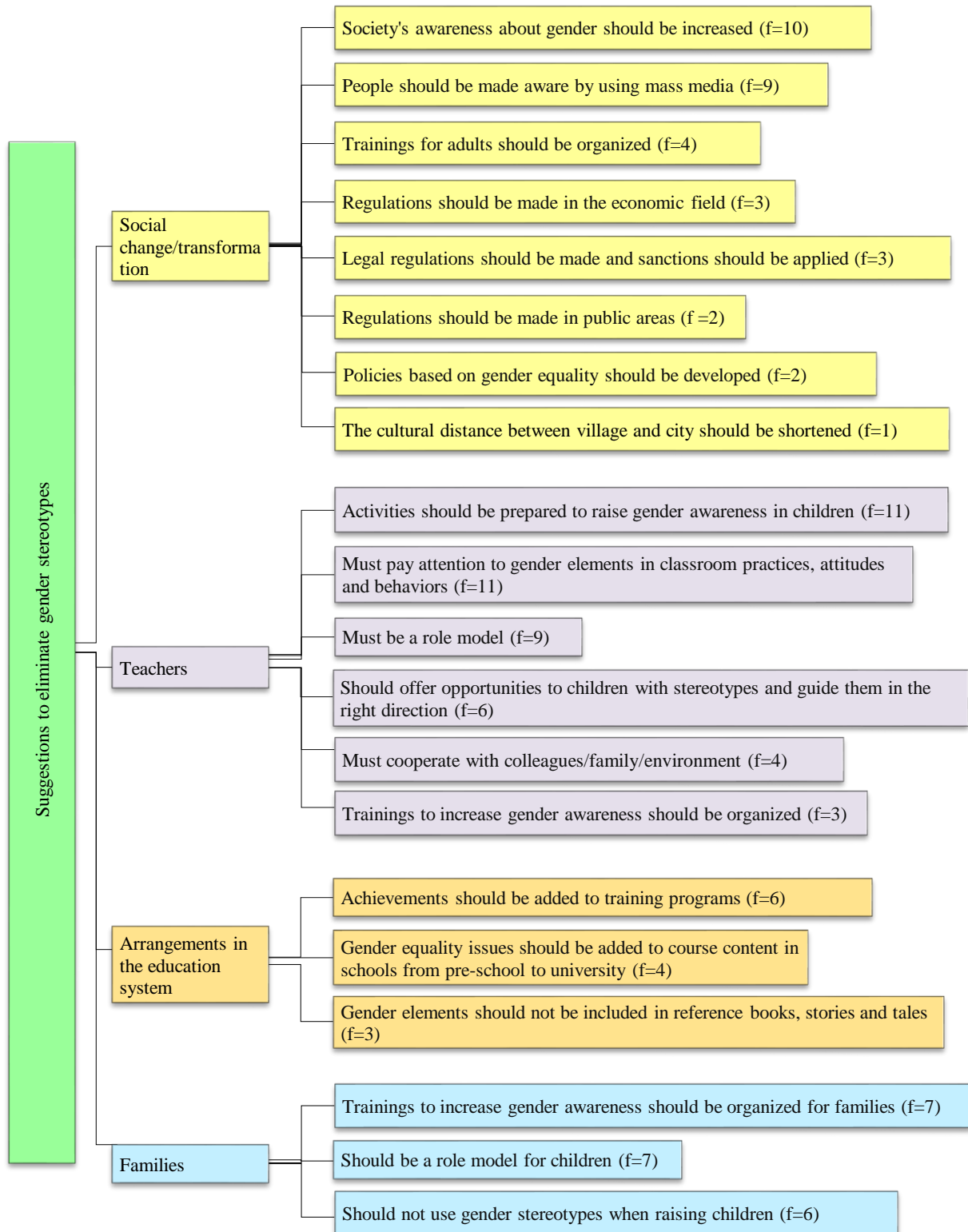
Figure 4. Preservice Preschool Teachers' Suggestions for Eliminating Gender Stereotypes

In order to make the subject more descriptive, some of the suggestions developed by pre-service teachers to eliminate gender stereotypes are given below with direct quotations.

"...I think the change in identities to a single colour removed an important obstacle to stereotypes. Because the fact that pink and blue identity cards, which were characterised by men and women, were issued by the state according to gender and at the moment we were born was something that reinforced gender stereotypes. Women are less visible in society than men. We see this even in the number of deputies..." (T4)

"...Discourses such as "Men cannot be pre-school teachers, men do not wear pink, women should break their knees, stay at home and take care of their children" need to change. If there are live examples of this in society, taboos and stereotypes will gradually break down.   Education starts in the family, continues at school and continues outside. Raising awareness of the environment and starting education at a young age would be a revolutionary step to prevent stereotypes. I think pre- school education is very important in this sense... " (T25)

"...In addition, a supra-governmental policy must be defined and implemented by the state and the inequality of gender stereotypes must be resolved. These policies should be implemented in all areas, from education to health, from finance to agriculture. Women and men should be treated and supported equally everywhere. One way to prevent gender stereotypes is through economic freedom. By eliminating wage differences, women should be able to stand more upright in social life. If these policies are followed and the level of education following science is increased, these stereotypes and judgements can be prevented..." (T28)

In Figure 4, it is seen that six different suggestions developed by pre-service teachers to eliminate gender stereotypes are related *to teachers*. The suggestions that teachers should prepare activities to create gender awareness in children (f=11), pay attention to gender elements in classroom practices, attitudes and behaviours (f=11), and be role models (f=9) stand out in this category. Further recommendations proposed by participants for educators encompass the following: affording children characterized by gender stereotypes the opportunity for constructive engagement and appropriate guidance (f=6), fostering collaboration with colleagues, families, and the broader environmental context (f=4), and organizing instructional programs geared towards enhancing teachers' gender awareness (f=3). Noteworthy suggestions within this category are exemplified below through direct quotations.

"...Teachers should ensure that all students benefit from all centres and toys without discriminating between girls and boys. When necessary, they should encourage children to play with different games and materials by getting involved in the games themselves..." (T17)

"...Gender stereotypes are taught to children not only by the family and social environment but also by mass media such as advertisements, television, newspapers, magazines, music videos, song lyrics, children's stories, fairy tales and textbooks. For example, today we see that story books for children are grouped as "for girls" and "for boys". This is also the case with toys produced for children. For

example, toys are produced in pink for girls and blue for boys. The child can form these stereotypes even from the TV series that the family sits and watches at night..." (T16)

"...I think trainings should be organised to raise teachers' awareness about gender. We see that there are teachers who behave with these stereotypes in the classrooms. I think that teacher trainings are important for teachers to manage the class by going beyond stereotypes and to raise children with this awareness of equality. I think that teachers should be trained with seminars during or after university..." (T19)

In the category of *arrangements in the education system in* Figure 4, it is seen that pre-service teachers developed three different suggestions to eliminate gender stereotypes. The participants most frequently (f=6) suggested that achievements should be added to education programmes. In addition; "Gender equality issues should be added to the course content in schools from preschool to university" (f=4), "Gender elements should not be included in resource books, stories and fairy tales" (f=3) suggestions are also prominent in this category. In order to be more understandable, some of the suggestions developed by the participants are given below with direct quotations.

"...The basis of these lies in education, and I think that pre-school education has a more important place in this regard. If children are given this education during their critical periods, a big step will be taken for change..." (T39)

"...Topics related to human rights and freedoms and gender equality can be included in the school curriculum. Maybe even a separate course on character development can be organised and topics related to the concept of gender can be included in that course. Because gender is a subject that affects our character to a great extent. For example, a man wants to wear earrings, but he gives up wearing them thinking about what people will say. Afterwards, he realises that he has formed his character in line with the stereotypes of the environment and gets upset..." (T25)

"...Children should also be careful in choosing toys and books. Visuals that do not emphasise gender stereotypes should be preferred in visuals such as books, videos and pictures to be used in the classroom. In the fairy tales read for children, female characters who are victims of violence are portrayed as poor and abandoned. Male heroes, on the other hand, save the heroine by kissing her, fighting the enemy, killing the enemy, taking her to his palace or breaking the spell. Older women in fairy tales are also often characterised as witches, wicked or stepchildren. The diversity in the heroism of male representation is absent in female representation... Such stereotypes in stories and tales can be presented by changing or comparing them..." (T10)

In the last category in Figure 4, it is seen that pre-service teachers made suggestions for *families* to eliminate gender stereotypes. The frequency of the suggestions for families to organise trainings to increase gender awareness (f=7) and for families to be role models for children (f=7) is the same. Another prominent suggestion in this category is that gender stereotypes should not be used when raising children (f=6). Some of the suggestions developed by the participants for families are given below with direct quotations.

"...Families also play a big role in the formation of these stereotypes. Children adopt and accept the stereotypes they see from their families. Families can be spoken to for this. Families can be trained. By cooperating with families, it can be ensured that families get rid of such stereotypes and become role models for their children. Sometimes, no matter how much we show our children, there is an imbalance in children when they encounter opposite examples at home. Therefore, we need to carry out this process in co-operation with the family..." (T36)

"... Families should set an example for their children with the distribution of work at home. Families should make careful choices about the film series watched at the same time. They should also be careful in choosing toys and books for their children. Of course, another important thing is to carry out studies to educate families on this issue..." (T33)

"...The fact that parents love their children with gender judgements is of course one of the most important factors triggering this. Boys are always lions and girls are princesses...Thus, the child starts to be intertwined with the concept of gender for the first time in the family. These stereotypes are formed at the very beginning by saying 'this is a man's colour, this is a man's toy, this is a man's job, this is a woman's job'. It is important for families to raise awareness in order to overcome these..." (T13)

Discussion, Conclusion and Recommendations

In this study conducted to reveal the views of pre-service teachers on gender in preschool education, all of the pre-service teachers defined the concept of gender, stated that they found gender elements in the behaviours of children and teachers and made suggestions. The education of children begins in the family and continues in schools through teachers. It is a fact that all kinds of educational activities have an important place in the development of the child. The necessity of the support of families and teachers especially in the attitudes and behaviours gained by children in early childhood years cannot be denied. It would not be wrong to say that planned and programmed activities performed in cooperation with families in preschool education institutions can create awareness about gender from early years in the lives of individuals. From this perspective, it is apparent that this circumstance holds the potential to make a meaningful contribution to societal change and the advancement of gender equality. In light of this consideration, this research study was centered upon the examination of gender-related aspects within the domain of preschool education, with the resultant formulation of recommendations, all of which were derived from the insights provided by pre-service educators.

Firstly, pre-service teachers were asked to define the concept of gender. *In their definitions,* the participants emphasised the parser, imposing and artificializer features of the concept of gender. The participants used definitions of gender such as attributing roles/expectations/behaviours/values/norms on people, and putting people into unnatural patterns to behave in accordance with their gender. In addition, the participants emphasised that gender is specific characteristics that can be observed externally and that differ from society to society/time/culture, and described the concept as people learning the roles of men and women. From this point of view, it is possible to say that the definitions formed by the participants are similar to the definitions of gender in the literature. For example, Torgrimson & Minson (2005) define gender as behavioural, cultural or psychological characteristics typically associated with sex. Cornell

(2009), points out that individuals gain a place in the gender order by the way they behave in daily life or that they respond to the place assigned to them. The definitions formed by the participants within the scope of this study are similar to the statements of the mentioned authors.

According to the results of the research, pre-service teachers point out that they observed *gender elements in the behaviours of preschool children*. One of these elements is related to children's preferences. The participants underlined that they observed elements of gender in children's preferences such as games/toys, colours, occupations, items such as clothes/accessories, appearance such as long hair, songs and films. Furthermore, an inference was drawn that gender-related attributes manifested within children's artistic renderings. This aligns with existing literature, as evidenced by studies conducted by Alabay & Özdemir (2020), Emeksiz & Bay (2022), Karniol (2011), and Wood et al. (2002), which yielded results congruent with those obtained in the current investigation. Emeksiz & Bay (2022), for instance, conducted an observational study involving 30 kindergarten children engaged in dramatic play, and their findings demonstrated the presence of gender stereotypes in the children's toy and material preferences, with girls gravitating towards dolls and boys exhibiting a preference for car-type toys such as trucks. Karniol (2011), in an examination of the impact of gender stereotypes concerning color (pink vs. blue) and illustration (Batman vs. Bratz), revealed that colors and objects were influenced by gender connotations, with color selection serving as an expression of an individual's gender identity. In the study conducted by Wood et al. (2002), it was revealed that parents prefer to buy gender-appropriate toys for their male children. It is a fact that the toys that parents buy according to the gender of their children will create gender stereotypes in children. As a result of the research conducted by Alabay & Özdemir (2020) to determine the gender perceptions of 36-72-month-old children attending preschool institutions towards professions, it was concluded that a high proportion of children perceived the professions of nurse, tailor, teacher, cook, cleaning staff as female gender-specific professions, and the professions of mechanic, construction equipment operator, captain, football player, pilot, firefighter, police officer, announcer, singer and cabin attendant as male gender-specific professions. In this study, it was determined that pre-service teachers encountered gender stereotypes (girls cannot be soldiers, boys can be policemen, etc.) in the profession preferences of preschool children in classroom practices. Another result obtained in this study is that there are gender discourses/polarisations in children's peer relations, especially in peer communication, and that they evaluate each other with gender stereotypes. Similar to this result, Witt (2006) argues that strict adherence to traditional gender roles is strongly encouraged by the peer group and supported by parents, school and media.

In the study, it was concluded that *teachers commonly used* gender stereotypes while managing children's behaviours in the classroom, giving instructions, reinforcing children and communicating with them, directing children to activities according to their gender, and distributing tasks/roles. In addition, it was determined that teachers included gender elements in activities and classroom arrangements. In the study, it was also concluded that teachers expect children to behave in gender appropriate role behaviours, evaluate the appropriateness of children's behaviours/preferences to gender, and have expectations from families about raising children according to gender roles. In addition to all these, it has been determined that there are also teachers who are aware of gender issues. To illustrate it in more detail, as a result of this research, it was found that teachers used "lion" for boys and "princess" for girls when managing children's behaviours in the classroom, preferred figures and colours for girls (e.g. pink Barbie doll) and boys

(blue Jackson Storm car) in activities, directed girls to the dramatic play centre and boys to the block centre during free play time, assigned girls as "nurse" and boys as "soldier" when distributing roles, and divided girls and boys into separate groups in classroom games. There are studies in the literature that coincide with the results of this study. For example, Akkaya (2023a) points out that gender roles are reproduced in schools through teachers. In the study, similar to the findings of this study, teachers mostly make discourses and behaviours towards female students to sit ladylike. Trepanier-Street & Romatowski (1999) underlined that since children are in the process of developing gender schemas and their ways of thinking are particularly susceptible to environmental influences, it is critical for teachers to use activities that promote a worldview based on gender equality. It is important that children are exposed to non-stereotypical models in early childhood so that they can see various occupations, activities and roles as options.

In the study, pre-service teachers made suggestions for social change/transformation, teachers, regulations in the education system and families to eliminate gender stereotypes. The *suggestions* developed by the participants to eliminate gender stereotypes are as follows.

For social change/transformation; awareness of the society on gender should be increased, people should be made aware by using mass media, trainings should be organised for adults, regulations should be made in the economic field, legal regulations should be made and sanctions should be applied, regulations should be made in the public sphere, policies based on gender equality should be developed, and the cultural distance between the village and the city should be shortened. In the mass media, women's identity is defined as an object that has no property rights over its own body, contributing to the formation and establishment of the image of women in the collective consciousness of the society according to good and bad evaluations, especially television is known to be more effective in the formation of gender roles than printed media (Mora; 2005; Uluyağcı & Yılmaz, 2007). Change/transformation should be initiated to eliminate gender stereotypes through the language used in visual, printed or social media, the content produced and egalitarian discourses, and gender equality should be supported through mass media. It would not be wrong to say that legal injustice, which can be considered as a situation that causes gender reproduction, actually emerges with gender discrimination. It is an important obligation to be aware of prejudices based on culture, tradition and other reasons related to gender inequality, to prohibit them in legal norms, and to reflect a perspective based on gender equality both in norms and in the perspective of law practitioners. In other words, it is necessary to be aware of the prejudices and stereotypes that support and perpetuate gender inequality and to create and implement legal norms with this awareness. In addition, it is another important obligation to clearly set out norms that eliminate inequality in economic terms (Uygur, 2015). Inequalities constitute impediments to the attainment of sustainable development, with the substantial disadvantages experienced by women representing a prominent source of such disparities. Augmenting women's engagement in the workforce exerts a favorable influence on economic advancement while concurrently enhancing their standing within both societal and familial contexts (Şahin & Bayhan, 2020). Therefore, it is necessary for sustainable development to make arrangements that will increase women's participation in employment and eliminate inequalities in labour markets. Özaydınlık (2014) underlined that education is the most important factor that determines the role of women in economic development and helps them to fully participate in employment. In addition to being employed in precarious jobs with low wages, it is known that women's domestic roles, especially childcare, in traditional family structures create obstacles to their participation in employment. Increasing women's education level

and employment participation rates will be significant intermediaries in eliminating gender inequality and gender stereotypes.

Teachers should prepare activities to create gender awareness in children, pay attention to gender elements in classroom practices, attitudes and behaviours, be role models, offer opportunities to children with stereotypes, guide them correctly, and cooperate with colleagues/families/environment. In addition, trainings should be organised for teachers to increase gender awareness. Bayraktar & Yağan-Güder (2019) underlined that teachers perpetuate stereotypes of gender roles in the classroom, either consciously or unconsciously, and that teachers' beliefs and expectations about gender roles affect children's behaviour. Researchers emphasise that teachers have the most important power to create a non-sexist education and that it is important for teachers to know what they can do in the classroom about gender equality and what ways they can help children develop an egalitarian perspective.

Necessary arrangements should be made in the education system by adding achievements to the education programmes, adding gender equality issues to the course content in schools from preschool to university, and emphasising gender equality in resource books, stories and tales. Trepanier-Street & Romatowski (1999) emphasise that high quality children's books are a valuable resource for introducing children to non-stereotypical models and that the use of children's literature and related classroom activities is a powerful tool for influencing children's gender attitudes. Gürşimşek & Günay (2005) point out that illustrated children's books, which are one of the stimuli presented to children in the preschool period, give important messages with the way they deal with traditional gender role patterns and behaviours common in society.

Trainings should be organised for families to increase gender awareness, families should not use gender stereotypes while raising children and should be role models for their children. According to traditional gender roles and stereotypes, men are assigned the task of providing for the household (work orientation), while women are assigned tasks such as child care and responsibility for family life (family orientation) (Moya et al., 2000). It is possible to say that these traditional gender roles assigned to women and men by the society are effective in family structures, in the way families raise children, and thus in children's formation of gender stereotypes. Yağan-Güder & Güler-Yıldız (2016) examined the role of family in preschool children's gender perceptions and found the following findings: Factors such as mothers being housewives, mothers being subjected to violence and children witnessing it, and traditional distribution of responsibilities within the family are effective in children's stereotypical views on women and men. In the aforementioned study, it was determined that children whose mothers and fathers took responsibility for housework together were less stereotypical about domestic responsibilities. To put it briefly, parents' encouraging fair behaviour in terms of gender and behaving in a fair manner in terms of gender will set a positive example for their children (Witt, 2006).

In conclusion, it is possible to say that gender roles, which can be described as the roles assigned to individuals according to their gender, and stereotypes attributed to these roles are reproduced through the society itself and social institutions, although they vary according to time/space/culture. Education is the most important way to ensure that there is a break in this reproduction process and that there is a change/transformation in gender over time. In this study, an evaluation that will shed light on child rearing and education policies for the elimination of gender inequality by

examining gender in preschool education in depth has been made. This study is anticipated to foster heightened consciousness pertaining to gender-related issues, facilitate the eradication of gender stereotypes, and bolster the advocacy for gender equality, particularly commencing in early childhood, among both families and educators.

Ethic

Funding

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Examination of the Interactive Digital Mathematics Games According to NCTM Standards

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Abstract

This study aimed to examine the interactive digital games that are open to access at the secondary education level on the Education Informatics Network [EIN] platform according to NCTM standards. 20 interactive mathematics games that are open to access on the EIN platform have been reached. Accessed games were analysed descriptively with a code book developed by Joung and Byun (2021) based on the NCTM Content and Process Standards. According to the results of the study, it was determined that the majority of the games are focused on the Numbers and Operations. All of the games targeted fifth and sixth graders, and no games were included for probability domain. Geometry has the highest mean scores for content standards while algebra has the lowest. Games related to geometry, measurement, and numbers exhibit a moderate degree of alignment with the underlying content domains, whereas games centered on data and algebra show a relatively weaker correspondence between the content and the contextual aspects of the game. On the other hand, as for the process standards, algebra has the highest mean scores while geometry and numbers have the lowest mean scores. Highest mean scores for process standards belong to problem solving for data, reasoning and proof for measurement, connections for data and algebra, representations and communication for algebra. Among the process standards, reasoning and proof, and communication were represented with the lowest means for all domains. Considering the results it is advisable to revise digital interactive mathematics games to meet the content and process standards.

Key Words

Educational games • Mathematics education • EIN • NCTM content and process standards

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Introduction

Research on games has revealed that games are not only pleasant time, entertainment, recreation and leisure activity, but also highly effective educational tools (Uğurel & Moralı, 2010). Such educational games can make lessons enternatining and eliminate students' negative attitudes and bias (Koç Deniz, 2019). They can increase the quality of learning by turning learners into active learners while increasing their motivation, thus serving as an effective learning environment (Chizary & Farhangi, 2017; Ibrahim & Jaafar, 2009; Pilten et al., 2017; Song & Zhang, 2008). Games are also used as effective educational tools to improve learning and understanding of complex topics (Chizary & Farhangi, 2017). Despite the existence of various categories of educational games, digital games, including but not limited to puzzles, simulations, and action and adventure games, are among the most extensively employed within the educational context (Connolly et al., 2012).

In the literature, researchers' definitions and classifications of digital games vary (Malone, 1981; Prensky, 2001). For instance, according to Spires (2015), digital games can be defined as multimodal texts, which consist of a combination of communication tools, including static and dynamic images, sound, music, speech, and writing. Samur (2016), on the other hand, defined digital games as "games with certain rules and objectives, played through a hardware (mobile phone, tablet, game console, etc.)". De Freitas (2006) defines digital games as "applications that use the features of video and computer games to create intriguing and immersive learning experiences to achieve specified learning objectives, outcomes and experiences". In an alternative characterization, digital games are delineated as interactive activities imbued with a rewarding framework structured around specific objectives (Vogel et al., 2006). It is evident from these delineations that the definition of digital games is subject to variability contingent upon the specific emphasis placed on distinct features. The concept of digital educational game-based learning, which emerged with the integration of digital games into learning environments, can be defined as the combination of interactive entertainment and formal learning through digital games (Anastasiadis et al., 2018). Digital game-based learning is an important approach to learning due to its promotion of contextualized learning, motivation provision, and encouragement of curiosity (Gee, 2007; Kirriemuir & McFarlane, 2004; Prensky, 2006). Van Eck (2015), emphasizing the connection between digital games and context, defined digital game-based learning as "the use of an existing course, class, or other teaching contexts where the primary objective is learning rather than mere entertainment. It has been stated by many researchers that digital games are effective in the teaching-learning process (Alexiou & Schippers, 2018; Herger, 2014; Prensky, 2001). It is important to use digital learning environments to provide sustainable learning experiences for students who grow up with technology (Gareau & Guo, 2009; Prensky, 2001). Educational digital game-based learning is worthy of preference in learning environments because it provides fun learning (Anastasiadiset al., 2018; Gee, 2003; Prensky, 2001). Within these instructional environments, students engage in the process of realizing, acquiring, utilizing, or applying targeted information while actively participating in digital games (Kim et al., 2009). Additionally, the element of enjoyment exerts a positive influence on students' enthusiasm for learning, thereby enhancing their overall motivation (Alaswad & Nadolny, 2015; Alexiou & Schippers, 2018; Joung & Byun, 2021; Hamari et al., 2016; Landers & Landers, 2014; Peterson, 2010; Prensky, 2001; Ray & Coulter, 2010; Ribeiro, 2019; Spires, 2015). It is also possible to ensure the attention of the students about the information to be learnt through educational digital games and to attract the student's interest

(Alexiou & Schippers, 2018; Deng et al., 2020; Ebner & Holzinger, 2007; Liu & Chu, 2010). It is stated that there is an increase in students' academic achievement thanks to educational digital games that make the learning-teaching process efficient (Acquah & Katz, 2020; Joung & Byun, 2021; Ding et al, 2017; Landrs & Landers, 2014; Tangkui & Keong, 2020; Wang & Chen, 2010; Yüksel, 2019).   Research findings substantiate that educational digital games stand out as both a highly favored and efficacious instructional tool within the realm of education (Riopel et al., 2019).

Educational Digital Games in Mathematics Education

The opportunities presented by digital games in the teaching and learning process have spurred their rapid adoption in education (Sykes, 2018). Numerous studies examining the utilization and impact of educational digital games in mathematics learning environments concentrate on the pivotal role of these games in enhancing students' mathematical knowledge and problem-solving skills (Acquah & Katz, 2020; Barros et al., 2020; Bofferding & Hoffman, 2019; Cramer, 2019; Devlin, 2011; Drijvers et al., 2014; Kärki et al., 2021; Lee et al., 2023; Meletiou-Mavrotheris & Prodromou, 2016; Ramani & Siegler, 2011).   It can be asserted that digital games hold significance in the realm of mathematics education, particularly in the cultivation of problem-solving skills, which occupies a central role. Students afforded the opportunity to engage with problem situations structured within a captivating and thought-provoking context have demonstrated noteworthy enhancement in their problem-solving capabilities through the utilization of educational digital games (Acquah & Katz, 2020; Dai et al., 2022; Gros, 2007; Hwang et al., 2015; Issa, 2007; Jenkins et al., 2006; White & McCoy, 2019; Spires, 2015; Sun et al., 2022). Furthermore, their dispositions towards problem solving have exhibited a positive transformation as well (Dayo et al., 2021; Dweck, 2015). In addition, educational digital games improve students' mathematical reasoning skills (Bakker et al., 2015; Ke, 2014; Kolovou, & van den Heuvel-Panhuizen, 2010; Olson et al., 2007). One of the significant opportunities that games offer within mathematics learning environments pertains to students' attitudes towards mathematics. Educational digital games have a positive impact on students' attitudes toward mathematics (White & McCoy, 2019). Educational digital games also enable children to use mathematical language as a communication tool in mathematics classrooms (Moyer-Packenham et al., 2019; Umbara et al., 2021). By means of educational digital games, students are exposed to various representations of mathematical knowledge and engage in their utilization (Moyer-Packenham et al., 2019). Within the Turkish context, it can be asserted that one of the foremost resources for educational digital games is the Education Informatics Network.

EIN as an Educational Digital Game Resource in Turkey

Education Informatics Network (EIN), which is an important and official source for educational digital games in Turkey, is a digital platform open to the use of students, parents and teachers within the Ministry of National Education. EIN, which started its publishing life in 2012, has been renewed and enriched with changing needs and has become one of the world's largest learning object warehouses (Tuluk & Akyüz, 2019). The primary goal of the EIN platform is to facilitate the effective utilization of educational materials through information technologies and promote the integration of technology into education. EIN offers reliable and vetted e-content suitable for grade levels and continues to develop by following innovations in education and technology (Üce, 2019). For this purpose,

it provides students with reliable and accurate content suitable for their purposes inside or outside the school (İskender, 2016). When EIN is evaluated in terms of secondary school mathematics teaching, it is seen that there are various contents aiming to provide students with the learning objectives in the secondary school mathematics curriculum. One of these contents is digital games. EIN is a constantly updated platform open to development and change. In this context, it is necessary to examine whether the contents in EIN, especially secondary school mathematics games, have sufficient content. When the research conducted on the EIN platform is examined, it is found that there are studies on the effect of EIN-supported teaching on students' academic achievement, academic self-regulation and basic psychological needs (Haskanlı, 2021). Research endeavors have encompassed investigations into the contents of the EIN through the lens of Bloom's taxonomy (Günbaş & Öztürk, 2022), as well as examinations aligning with the seamless learning principles articulated by Wong and Looi (Poçan & Yaşaroğlu, 2017). Additionally, inquiries have been undertaken to elicit the perspectives of educators regarding EIN activities (Kepceoğlu & Ercan, 2019) and to gather insights from both educators and prospective educators concerning the games available on this platform (Tuluk & Akyüz, 2019). Therefore, when the relevant literature is examined, it can be stated that there are insufficient studies dealing with the game contents of secondary school mathematics course among the EIN platform contents (Günbaş & Öztürk, 2022). Considering that the effective use of games, especially as a cognitive development-oriented educational tool or teaching method, is very important, it is noteworthy to systematically examine game design (Pilten et al., 2017), especially the games on the EIN platform (Günbaş & Öztürk, 2022) for maximum educational benefit. Indeed, digital games can serve as valuable tools for creating efficient learning environments. Nevertheless, attaining such efficiency requires meticulous discernment in the selection of games that exhibit a high degree of alignment with the specified educational objectives and desired learning behaviors (Prensky, 2001). Ensuring that these goals and behaviors align with both the nation's own educational programs and globally recognized common norms and standards is of paramount importance. As a matter of fact, to the extent that countries implement practices in accordance with these norms, they are respected and take their place in international platforms (Umay et al., 2006). The delineation of eight pivotal competencies within the Turkish Qualifications Framework (TQF) as outlined by the Ministry of National Education (MoNE, 2018), and their incorporation into the Mathematics Curriculum in Turkey, underscores the significance attributed to these shared standards within the Turkish educational system. These competencies are deemed essential for students' proficiency in their personal, social, academic, and professional pursuits, both domestically and in the global context. One of the most internationally recognised organisations in mathematics education is the National Council of Teachers of Mathematics [NCTM].

NCTM Standards

Founded in 1920 in the United States, NCTM, the world's largest mathematics organisation (NCTM, 2023, https://www.nctm.org/About/), established the Commission on Standards for School Mathematics in 1986 to help improve the quality of school mathematics (Toumasis, 1997). With the establishment of this commission, NCTM published The Principles and Standards for School Mathematics in 2000, which provides a vision for establishing basic educational guidelines for grades preschool through K12 (Deal & Wismer, 2010). The objectives delineated within the Principles and Standards for School Mathematics, promulgated by the National Council of Teachers of

Mathematics (NCTM) in the year 2000, encompassed the following facets: the formulation of comprehensive and logically interconnected learning goals spanning the entire educational spectrum from preschool to K-12; the provision of a toolset for educators to appraise and gauge the caliber of mathematics curricula; the provision of guidance for the construction of curriculum frameworks, evaluation methods, and educational resources; and the facilitation of dialogues aimed at devising effective strategies for nurturing students' attainment of foundational mathematical comprehension (NCTM, 2000). Therefore, this guiding document highlights the essential components of a high-quality school mathematics programme, provides a common mathematical foundation for learning by all students (NCTM, 2000), and suggests how to achieve and support a mathematically rich school environment (Midgett & Eddins, 2001). Furthermore, the standards outlined in this document define the mathematics that students should understand and apply (Joung & Byun, 2021). The standards are discussed under two headings: process and content standards. The quintet of Content Standards (Numbers and Operations, Algebra, Geometry, Measurement, Data Analysis and Probability) unambiguously delineate the specific domains of mathematical knowledge that students are expected to acquire. In contrast, the quintet of Process Standards (Problem Solving, Reasoning, Probability and Proof, Communication, Connections, Representations) underscore the methodologies and approaches relevant to the acquisition and application of said content knowledge. Research demonstrates that textbooks aligned with NCTM standards enhance students' learning outcomes, boost their mathematical knowledge and skills, and contribute to the professional development of teachers and educational leaders (Alabdulaziz & Higgins, 2021). Similarly, it is stated that NCTM process standards can provide effective challenging mathematics environments for children and develop their higher-order thinking (Stoll, 2015). Based on the results of the research, it can be stated that NCTM process and content standards are very effective in realising the desired mathematics education. Students and teachers will experience the mathematics education envisaged by the NCTM standards only with the support and leadership of school and district administrators because administrators have the opportunity to contribute to the development of mathematics education at many different levels through the implementation of mathematics principles and standards, policies and structures in their schools, the selection of instructional materials, and the support of teachers' professional development (Midget & Eddins, 2001). Therefore, examining the extent to which the content produced and supported by education policy makers in countries is in line with the NCTM standards will give clues as to where they are in terms of achieving the desired mathematics education. There are obviously many aspects of classroom practice, including the content presented and the nature of classroom instruction, that can influence student achievement and be relevant to future policy debates. However, it is clear that evaluating the content used by teachers in the light of NCTM standards represents an important basis for improving mathematics teaching and learning (Alabdulaziz & Higgins, 2021). The studies in the literature focused on the topics of examining digital games from an educational perspective (Gözüm & Kandır, 2021); the effects of digital mathematics games on student performance and attitudes (Cai et al., 2022; Jarrah et al., 2022; Kolovou et al., 2013; Luo et al., 2022; Starkey, 2013; White & McCoy, 2019), mathematical reasoning (Jensen & Scott, 2022), mathematical problem-solving attitudes (Dayo et al., 2021) and problem-solving performance (Sun et al., 2022); examining the design features of digital games (Moyer-Packenham et al., 2020); opinions of teachers and students about digital games (Özata & Coşkuntuncel, 2019; Yong et al., 2016). Two studies were found that examined games according to NCTM standards (Arabacı, 2021; Joung & Byun, 2021). In their research, Joung and Byun (2021)

examined the digital games that were discussed in previous studies and are still accessible according to NCTM standards. Arabacı (2021) examined the games designed by teacher candidates according to NCTM standards. Therefore, there is no study examining the digital games on EIN, which is an important and official source for educational digital games in Turkey, according to NCTM standards. From this vantage point, the primary objective of this investigation is to conduct an analytical assessment of the digital games within the EIN, a significant and officially sanctioned repository for educational digital games established under the auspices of the Turkish Ministry of National Education. This analysis will be conducted with a specific focus on discerning the alignment of these digital games with the content and process standards articulated by the National Council of Teachers of Mathematics (NCTM).

Method

Research Design

This study employs a quantitative research methodology, which focuses on collecting and analyzing numerical data. A case study research design which presents a holistic view of a specific case was used in the present study (Yin, 2016). Given the comprehensive scrutiny of interactive mathematics games within the framework of NCTM standards, the present research employs a corresponding research design.

Research Sample

The games examined were sourced from the Education Informatics Network's website (https://eba.gov.tr). Since this study focuses on evaluating interactive games, only those meeting this criterion were intended to be included. The games were searched for using the keywords of 'game' and 'mathematics' separately. Later on, the search was filtered according to grade level (5th, 6th, 7th and 8th), lesson (mathematics) and type of the content (games). This selection process resulted in a 20 interactive mathematics games in total. Furthermore, it is noteworthy that one of the games exhibited relevance to multiple learning domains, specifically encompassing both the domains of measurement and geometry. Therefore, a total of 21 coding scores from 20 games were analyzed in this study. Hence 21 coding scores out of 20 games have been analyzed within the study. All the games included were accessible and playable at the time of conducting this study.

Research Instruments and Processes

A codebook developed by Joung and Byun (2021) to examine the interactive mathematics games has been used to collect data. This codebook has been created taking NCTM (2000) content and process standards into consideration to analyze mathematics games. The codebook encompassed a categorization system consisting of two primary domains: Content Standards and Process Standards. The content standards comprise 41 itemsto examine the content of the games in terms of five learning domains, i.e. Number and operation (7 items), Algebra (10 items), Geometry (9 items), Measurement (4 items), and Data analysis and probability (11 items). The process standards include 28 items related to five areas which are Problem Solving (4 items), Reasoning and Proof (6 items), Communication (5 items), Connection (5 items), and Representation (8 items). All the items used a 5-point Likert

scale for coding, i.e. strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). While content standards vary across the learning domains, process standards remain the same for all learning domains.

Two coders independently evaluated and scored each of the games on the 5-point Likert scale according to the NCTM content and process standards. The items were scored based on the degree of the evaluator's agreement of the statement. The coding scores for ten chosen games were evaluated in terms of reliability. These scores have been used to calculate the interrater reliability using Cohen's Kappa statistic. To assess reliability, a single game representative of each learning domain was selected, and the coding scores for these five games were subjected to analysis, yielding a Cohen's Kappa statistic value of .88. According to Altman's (1999) classification, it was observed that there was a very good level of agreement between the game coding of two independent evaluators.

Data Analysis

The data recorded in a Microsoft Excel file were analyzed descriptively in the first place. Each of the games was analyzed based on the scores obtained from the coders. Means and graphical representations were presented to picture the characteristics of the games in terms of content and process standards. Mean scores of each category show the degree of alignmentinteractive games to the NCTM content and/or process standards. Means have been evaluated according to the classification of low (1-2.33), medium (2.34-3.67), and high (3.68-5.00) levels of alignment.The subdomains of process standards were analyzed using one-way ANOVA after ensuring that the normality assumptions were met. The data pertaining to all variables under scrutiny in the analysis exhibited normal distribution characteristics, as indicated by the skewness values ranging from 0.16 to 1.43 and kurtosis values ranging from -1.48 to 0.53, in accordance with the guidelines presented by Tabachnick and Fidell (2012).

Results

In this study, 20 different games were examined across grade levels and learning domains. As there is no game related to probability, the findings were presented for geometry, data, algebra, measurement, and numbers. Table 1 presents the distribution of the games.

Table 1.

Distribution of games according to learning domains and grade levels

Grade levels	5th	6th	7th	8th	Total	
					n	%
Geometry	1	-	-	-	1	5
Data	-	1	-	-	1	5
Algebra	-	1	-	-	1	5
Measurement	3	1	-	-	4	19
Numbers	9	5	-	-	14	66
Total	13	8			21	100

Table 1 shows that there are no games prepared for 7th and 8th grades. Most of the games (62%) were created for the fifth grades. The preponderance of the games, constituting 66% of the sample, was developed within the purview of the Numbers learning domain, with measurement learning domain ranking as the subsequent area of

focus. There is only one game for each of the geometry, algebra, and data. The games were further examined in terms of NCTM standards. The mean scores for content and process standards are presented in Table 2.

Table 2

Means of content and process standards across learning domains

	Geometry	**Data**	**Algebra**	**Measurement**	**Numbers**
Content standards	3.10	1.82	1.56	2.63	2.52
Process standards [PS]	1.43	2.04	2.36	1.99	1.51
PS_{Problem solving}	1.25	3.00	2.25	2.50	1.80
PS_{Reasoning and Proof}	1.33	1.00	1.00	1.67	1.07
PS_{Connections}	2.00	3.40	3.40	2.55	1.97
PS_{Representations}	1.38	2.00	3.13	1.97	1.60
PS_{Communication}	1.20	1.20	1.80	1.45	1.19

	Low level		Medium level

Table 2 presents that geometry has the highest means scores for content standards while algebra has the lowest. This means that geometry games are highly related with the geometry domain while algebra games lack the connection between the algebra content and the game context. Algebra has the highest means scores for process standards while geometry has the lowest. This observation signifies that geometry games, in their current manifestation, exhibit a deficiency in adhering to the process standards, albeit demonstrating alignment with the content standards. Notably, the process standards, particularly those encompassing connections, record the highest mean scores within the domains of algebra and data. Problem solving has the highest mean scores for data, reasoning and proof has for measurement, representation and communication has for algebra.Numbers and geometry have the lower mean scores for process standards compared with the other domains while they have higher content standards. The least mean score belongs to reasoning and proof for algebra, and data. Given that a score of 1 signifies the lowest ranking, it is apparent that these games exhibit a deficit in terms of content related to reasoning and proof. Figure 1 provides a visual representation of the distribution of mean scores pertaining to both content and process standards across various learning domains.
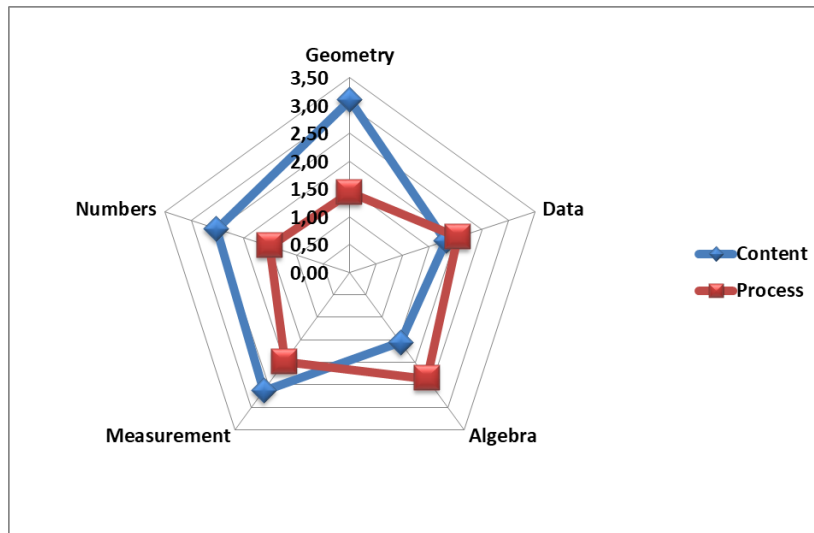
Figure 1. Comparison of content standards across learning domains

As Figure 1 also puts forth visually, geometry, numbers and measurement have the highest mean scores for content standards while algebra and data have the lowest mean scores. Moreover, algebra has the highest means scores for process standards while geometry and numbers have the lowest mean scores.

Figure 2 represents the distribution of the process standards across learning domains.
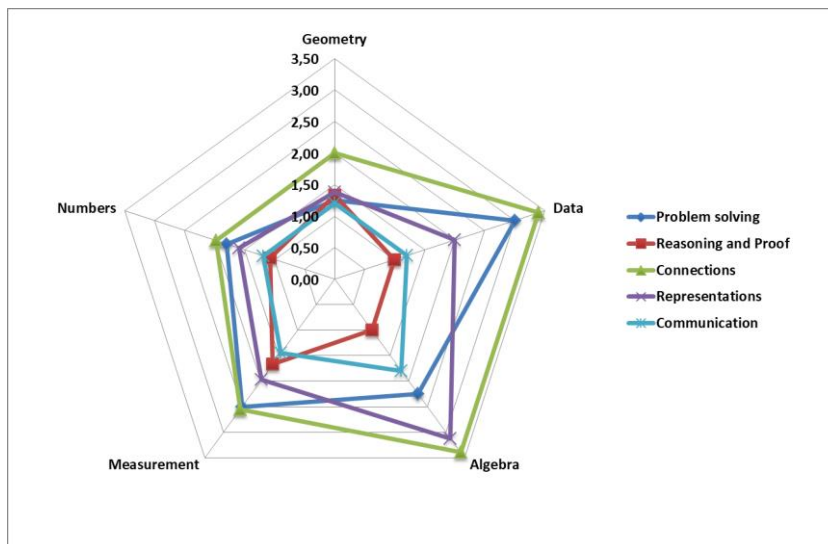
Figure 2. Comparison of process standards across learning domains

According to Figure 2, connection has the highest mean scores across all learning domains while reasoning and proof and communication have the lowest mean scores. This suggests that the games should be improved in terms of these process standards having the lowest mean scores. The comparison of learning domains has also been examined across the process standards, which is shown in Figure 3.
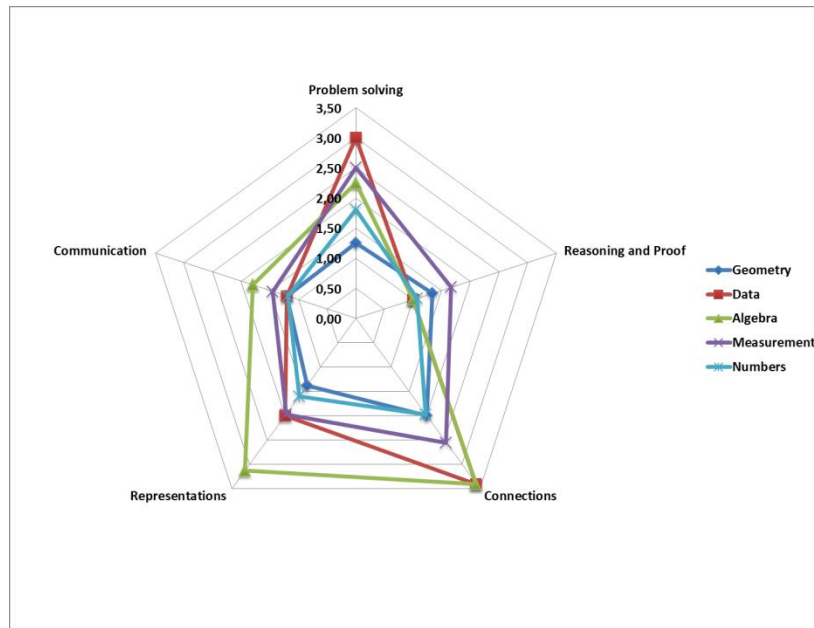
Figure 3. Comparison of learning domains across process standards

Figure 3 illustrates that algebra, data, and measurement have relatively the higher mean scores for process standards compared to the other learning domains. This suggests that the games related to numbers and geometry needs to be improved in terms of process standards.

While there is discernible variability in the process standards across the diverse learning domains, the assessment of distinctions among these process standards necessitated the application of a one-way analysis of variance (ANOVA). The outcomes of the ANOVA analysis are duly presented in Table 3.

Table 3

ANOVA results according to process standards

Subscales	Source of variances	Sum of squares	df	Mean square	F
	Between groups	2.09	4	.52	.95
Geometry	Within groups	12.75	23	.55	
	Total	14.85	27		
Data	Between groups	22.96	4	5.74	8.25**
	Within groups	16.00	23	.69	
	Total	38.96	27		
Algebra	Between groups	22.80	4	5.70	8.39**
	Within groups	15.62	23	.67	
	Total	38.42	27		
Measurement	Between groups	4.69	4	1.17	8.03**
	Within groups	3.36	23	.14	
	Total	8.06	27		
Numbers	Between groups	3.15	4	.78	6.82**
	Within groups	2.65	23	.11	
	Total	5.81	27		

ANOVA results suggest that there isnot a significant difference on geometry [$F(4, 23) = 0.95$, $p > .05$] according to the process standards. However there is a significant difference on data [$F(4, 23) = 8.25$, $p < .05$], algebra [$F(4, 23) = 8.39$, $p < .05$], measurement [$F(4, 23) = 8.03$, $p < .05$] and numbers [$F(4, 23) = 6.82$, $p < .05$] according to the process standards.

Post hoc comparisons using the Tukey HSD test indicated that the mean score of the problem solving (M = 2.50, SD = 0.35) was significantly different than reasoning and proof (M = 1.67, SD = 0.20), and communication (M = 1.45, SD = 0.41) for measurement. Moreover, the mean score of connections (M = 2.55, SD = 0.41) was also significantly different than reasoning and proof (M = 1.67, SD = 0.20) and communication (M = 1.45, SD = 0.41) for measurement.

A post hoc Tamhane test indicated that the mean score of the problem solving (M = 3.00, SD = 1.15) was significantly different than reasoning and proof (M = 1.00, SD = 0.00), and communication (M = 1.20, SD = 0.44) for data. Moreover, the mean score of connections (M = 3.40, SD = 0.54) was also significantly different from reasoning and proof (M = 1.00, SD = 0.00) and communication (M = 1.20, SD = 0.44) for data.

A further post hoc Tamhane test indicated that the mean score of the representations (M = 3.13, SD = 0.83) and connections (M = 3.40, SD = 0.89) was significantly higher than reasoning and proof (M = 1.00, SD = 0.00) for algebra. Moreover, the mean score of connections (M = 3.40, SD = 0.89) was also significantly higher than communication (M = 1.80, SD = 1.30) for algebra.

Another post hoc comparisons using the Tamhane test indicated that the mean score of the problem solving (M = 1.80, SD = 0.35) was significantly higher than reasoning and proof (M = 1.07, SD = 0.06) for numbers. Moreover, the mean score of connections (M = 1.97, SD = 0.47) was also significantly higher than reasoning and proof (M = 1.07, SD = 0.06) and communication (M = 1.18, SD = 0.28) for numbers.

Discussion, Conclusion & Suggestions

In the study, 21 interactive digital mathematics games at the secondary school level in EIN were analysed according to NCTM content and process standards. When the analysed games were examined in terms of content standards, it was found that the majority of the games were related to the number and operations learning domain, followed by the measurement learning domain. Furthermore, it has been ascertained that the EIN features only a solitary game each within the realms of geometry, data processing, and algebra learning domains, with a conspicuous absence of games pertaining to the probability domain. This notable disparity in the prevalence of games associated with the numbers and operations learning domain can be attributed to the fact that this domain encompasses the largest number of learning outcomes as stipulated within the secondary school mathematics curriculum (Arabacı, 2021). The fact that there are no games in EIN in the probability learning domain is thought to be due to the fact that there are very few objectives (5) in this learning domain in the curriculum and that these objectives are at the 8th grade level (MoNE, 2018; Arabacı, 2021). These results obtained from the research coincide with the results obtained by Joung and Byun (2019). Out of the 23 digital games examined by the researchers, 15 were related to the numbers and operations content standard, while none of the games met the data analysis and probability content

standard. Another result obtained in the study is that there are no mathematics games at the 7th and 8th grade level in EIN. Parallel to this result, Akkaş Dede (2021) found that technology-supported educational games in Turkey are concentrated at the 5th and 6th grade level in his study of 29 postgraduate theses. In this context, the question that needs to be addressed is 'why there are no games at the 7th and 8th grade level in EIN'. This situation may be attributed to an exam-oriented educational approach. As a matter of fact, studies show that teachers consider it a waste of time to play educational mathematics games for students who are in the preparation stage for exams (Özata & Coşkuntuncel, 2019); therefore, they think that the use of games in mathematics teaching is more suitable for younger age groups (Cai et al., 2022; Ülker & Bülbül, 2018). Ding et al.'s (2017) statements that there are very few studies on digital game-based learning at higher education level also support this view. However, digital games appeal to all ages and are especially interesting for children and young people (Gunter & Daly, 2012; Talan & Kalınkara, 2020; Toh & Lim, 2021). In addition, considering that games have a positive contribution at all grade levels at the secondary school level (Starkey, 2013; Toh & Lim, 2021), the lack of games at the 7th and 8th grade level can be described as a deficiency. Hence, it is advisable to consider the inclusion of interactive digital games within the EIN targeted specifically for 7th and 8th-grade students. It is noteworthy that the learning domain of "data processing and probability" within the secondary school mathematics curriculum comprises a notably reduced number of learning outcomes in comparison to the domains of geometry and algebra, as indicated by the Ministry of National Education (MoNE, 2018). However, despite this, as stated in the results of the study, there are only one game in the same number in the learning areas of data processing, geometry and algebra. Therefore, it is evident that the games in EIN do not align proportionally with the distribution of learning outcomes in the curriculum. In this context, it is suggested that the content of the games in EIN should be designed by considering the number of learning outcomes in the learning areas of the secondary school mathematics curriculum.

In the study, it was determined that the games for geometry, measurement and numbers and operations learning domains in EIN were related to NCTM content standards at a medium level, while the games for data analysis and algebra learning domains were related to NCTM content standards at a low levelIn other words, none of the games in EIN exhibit a high level of alignment with NCTM content standards.One of the reasons for this result may be the differences between the content for learning domains in the secondary school mathematics curriculum in Turkey (MoNE, 2018) and NCTM content standards. While not within the purview of this current study, it is worth acknowledging that the mathematics games hosted within the EIN predominantly concentrate on singular learning outcomes, emphasizing foundational skills at a rudimentary level.It was determined that the games for data analysis and measurement learning domains in EIN were related to problem solving process standards at medium level, while the others were related to problem solving process standards at low level. In other words, none of the games in EIN are highly related to problem solving process standards. Moreover, it is understood that the games in the learning areas of numbers and operations, algebra, and geometry lack problem solving standards. While this result aligns with the findings of Arabacı (2021), in contrast, the study conducted by Joung and Byun (2020) identified problem-solving as the most prevalent standard in games. This finding can be construed as suggestive evidence that the games available within the EIN may be deficient in terms of their emphasis on problem-solving abilities when juxtaposed with other digital games within the international landscape. Considering that problem solving is at the centre of

mathematics teaching (Baki, 2008; MoNE, 2018; NCTM, 2000), it is thought-provoking to obtain such a result. Therefore, it would be appropriate to construct the games by considering the problem solving process standard.

All of the games in EIN are associated with Reasoning and Proofs and communication process standards at a low level. The reason why the games are associated with the Reasoning and proof process standard at a low level may be due to the fact that the study focuses on games at the secondary school level. As a matter of fact, Zeybek et al. (2018) emphasised that words related to proof such as "proof, prove, inference, counter-example, refute" were never encountered in the textbooks, and only 177 of the 2831 mathematical activities they examined had the characteristics of reasoning and proof. Therefore, it is seen that proving is still not considered as a separate skill in secondary school curricula in our country (Öztürk & Demirel, 2021). Conversely, in accordance with the assertions made by Cooper et al. (2011), there exists a conventional paradigm positing the inclusion of proof-related content within the purview of high school and tertiary education, often reserving it exclusively for advanced mathematics contexts. Therefore, the fact that the experts who prepared the games have such a traditional perspective may also explain the result obtained. It is thought that the result that the games are related to the Communication standard at a low level is due to the fact that the games in EIN are individual games. As a matter of fact, Joung and Byun (2021) did not evaluate the communication standard in their research with the assumption that digital games are played individually. In this study, since the feedbacks in the games are also assumed to be communication, the communication standard was taken into consideration. Therefore, the result obtained can be interpreted as that the feedbacks in the games in EIN are insufficient. In contrast to this result, Arabacı (2021) stated that pre-service elementary mathematics teachers identified the communication standard the most in the games they designed. This difference is thought to be related to the type of game designed by the pre-service teachers in the study. As a matter of fact, all of the games designed in the related research are in the non-contact game type and these games are mostly designed as group games. As the researcher stated, it is an expected result that communication skills come to the fore in games played in groups (Arabacı, 2021). Within this context, it is conceivable to propose that games featured on the EIN platform should be meticulously crafted to accommodate multiplayer engagement, thereby facilitating concurrent participation by multiple users. Additionally, individual game designs should be structured to furnish ample feedback mechanisms to enhance the user's learning experience.

While the games for data analysis, algebra and measurement learning domains are moderately related to the connections process standard, geometry and numbers and operations learning domains are related at a low level. Again, it was observed that none of the games in EIN were highly related to the connection process standard. However, it is emphasised that connection is extremely important in mathematics teaching (MoNE, 2018; NCTM, 2000; Pambudi et al., 2020) and students' problem solving skills are affected by mathematical connection (Pambudi et al., 2020; Son et al., 2020); it is also known that there is a positive relationship between mathematical connection and productive thinking (Jawad, 2022) and mathematical reasoning (Hanifah & Karyati, 2019). Therefore, it can be suggested that revisions should be made to design games that are highly related to the connection standard. According to the results of the study, only the game representations for algebra learning domain is moderately related to the process standard. This may be due to the fact that algebra learning domain is highly related to representations by nature (Kaput, 1989). The games for other learning domains were found to be related to the

representations standard at a low level. In other words, most of the learning domains cannot fulfil the representations standard. Vergnaud (1987) stated that representations are a fundamental element for mathematics teaching and learning and Kaput (1987) stated that representations are the heart of the content of mathematics and are at the centre of mathematical activities. Indeed, the important role of representation in mathematics is strongly supported by NCTM (2000).

It was determined that the games belonging to the geometry learning domain in EIN were associated with all NCTM process standards at a low level. Also, no significant difference emerged in terms of process standards in the games belonging to the geometry learning domain. In other words, no process standard was emphasized in the geometry learning domain. Similarly, although the games belonging to the numbers and operations learning domain were associated with all process standards at a low level, it was found that the problem solving process standard differed significantly from reasoning and proof in the games in this learning domain. Additionally, connections standard is also significantly differentiated from reasoning and proof and communication. Therefore, although the games belonging to the numbers and operations learning domain do not meet the process standards, it is understood that these games are more related to the problem solving standard than reasoning and proof, and more related to the connections standard than reasoning and proof and communication. It was found that the games for the data analysis learning domain were more related to problem solving and connections standards; moreover, the relationship with these standards differed significantly from communication and reasoning and proof. Likewise, it is worth noting that the games within the measurement learning domain exhibited a moderate degree of correlation with problem-solving and connections. Within this specific learning domain, the scores associated with the problem-solving process standard displayed notable disparities when compared to the standards of reasoning and proof, as well as communication, signifying a significant differentiation among them. It was found that the games belonging to the algebra learning domain were moderately related to connections and representations process standards, and these standards differed significantly from reasoning and proof. Moreover, the scores belonging to the connections standard are significantly higher than communication.

In conclusion, according to the results of the study, the games in EIN do not meet any of the process standards at a high level. Moreover, there is no significant difference in terms of process standards in geometry learning domain. However, a significant difference was found in terms of process standards in the games belonging to data, algebra and numbers learning domains. In other words, some process standards are found more in the games belonging to data, algebra and numbers learning domains than others. Hence, it is deemed imperative to take into account the mathematical process standards both during the revision of existing games across all learning domains and in the developmental phase of new digital games. Considering that games enhance mathematics achievement in mathematics education, it is advisable to include more game-based content in digital platforms like EIN and in MoNE textbooks (Tarım, 2023).

Ethics

We declare that the research was conducted in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Author Contributions

All authors contributed equally to the study.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Investigation of Secondary School Mathematics Teachers' Processes of Preparing Mathematical Modelling Activities

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Abstract

In this study, it was aimed to investigate the mathematical modelling activity preparation processes of secondary school mathematics teachers who participated in mathematical modelling training. The study was conducted with six mathematics teachers working in secondary schools. In the study designed as action research, two action plans were applied to the teachers. The first activity forms collected from the teachers before the application, the second activity forms collected as a result of the theoretical training about modelling and the activity forms collected at the end of the active participation of the teachers in the modelling activities constitute the data source of this study. An activity evaluation form was used in data analysis. The results of the study showed that teachers initially had deficiencies in preparing modelling activities in accordance with all criteria. After the theoretical training given, it was determined that teachers' competencies in preparing modelling activities improved very little. In addition to theoretical training, it was seen that the learning environment prepared to ensure teachers' active participation in modelling activities affected their activity preparation competencies more positively. The results show that teachers' theoretical knowledge deficiencies should be eliminated in modelling teaching and learning environments should be prepared for their active participation in mathematical modelling activities.

Key Words

Mathematical modelling activity • Mathematics teacher • Principles of modelling task

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Mathematics curricula focus on the development of students' mathematical knowledge, thinking, skills and attitudes to solve the situations they may encounter in daily life. In this context, the importance of associating mathematics with real-life events and other disciplines is also emphasised (MoNE, 2011). In the 2017 curriculum for secondary school mathematics, as outlined by the Ministry of National Education, there was a notable shift in focus towards emphasizing the acquisition of fundamental skills in mathematical modeling. Within this context, a mathematical model is conventionally characterized as a mathematical construct that serves as a representation of real-world phenomena (Greefrath & Vorhölter, 2016). Blum and Borromeo Ferri (2009), on the other hand, elucidate mathematical modeling as a systematic process characterized by the reciprocal transformation of both the mathematical realm and the physical reality it seeks to capture. In this context, the importance of teachers' pedagogical content knowledge specific to mathematical modelling is emphasised in the literature (Borromeo Ferri, 2018; Wess et al., 2021).

According to the studies, it has been revealed that teachers' knowledge and skills about mathematical modelling are insufficient (Güder, 2013; Sağıroğlu, 2018; Sarı, 2019), they have difficulties in preparing and applying mathematical modelling activities (Çiltaş, 2015; Deniz & Akgün, 2017), and they do not tend to use mathematical modelling activities in mathematics lessons (Akgün et al., 2013; Işık & Mercan, 2015). The reasons for this situation include the fact that mathematical modelling is more widely used at the secondary level and above (Deniz & Akgün, 2017; Erbaş et al., 2013; Tekin Dede & Bukova Güzel, 2013; Urhan & Dost, 2016), it is newly included in the secondary school curriculum (MoNE, 2017), secondary school teachers' knowledge and skill levels are insufficient in this framework (Çiltaş, 2015; Güder, 2013; Sarı, 2019) and there are deficiencies in terms of resources (Şahin, 2019). This study focuses specifically on teachers' processes of developing mathematical modelling activities because developing mathematical modelling activities is an important practice for internalising and better understanding modelling (Borromeo Ferri, 2018). Similarly, the cultivation of effective modeling proficiencies may be promoted through the judicious application of well-chosen or purposefully crafted modeling exercises within the educational setting (Wess & Greefrath, 2020). This study is motivated, in part, by the dearth of modeling activities tailored to the secondary school level, a lacuna evident in both the official curriculum and extant scholarly literature (Şahin, 2019). An additional impetus for this investigation arises from the challenges faced by educators in the formulation of modeling activities, as documented in the works of Çiltaş (2015) and Deniz & Akgün (2017).

In the literature, studies that reflect the situation of mathematics teachers regarding their competencies in preparing mathematical modelling activities were examined. In the studies, mathematical modelling problems prepared by teachers or candidates were examined. Most of the studies show that teachers have deficiencies in preparing modelling activities (Bilgili et al., 2020; Dede et al., 2017; Deniz & Akgün, 2016; Stohlmann et al., 2017; Yu & Chang, 2009). Bilgili et al. (2020) first informed teachers about the theoretical framework of mathematical modelling and then asked them to create activities. As a result of this study, it was determined that very few of the activities prepared were in accordance with the principles for these mathematical modelling problems. In the study conducted by Bilgili and Çiltaş (2022), participants were asked to prepare mathematical modelling activities after the training in which theoretical information about mathematical modelling was provided. In the activities evaluated in line with the principles, it was observed that the most considered principles were realism and self-evaluation, while

the most ignored principle was the principle of generalising the model. Similar results were also found in the study conducted by Deniz and Akgün (2016) with mathematics teachers. Within the purview of this research, akin to prior inquiries, educators were tasked with crafting mathematical modeling exercises subsequent to attending informative sessions elucidating the tenets of mathematical modeling. The findings revealed that teachers encountered challenges in formulating activities that adhered comprehensively to the requisite criteria for developing modeling tasks, with several criteria remaining unfulfilled in numerous instances. In a related study conducted by Yu and Chang (2009), pedagogical activities generated by instructors following specialized training for mathematics educators were assessed against the backdrop of foundational modeling principles. When the activities were analysed, it was observed that they did not carry these principles sufficiently. The same findings were also found in the study conducted by Chamberlin and Moon (2008). In a study conducted by Stohlmann et al. (2017), the activities prepared by three mathematics teachers were evaluated within the framework of modelling principles. While two of the prepared activities could meet these principles, the other activity did not meet the principles of model generalisation and self-evaluation. Sağıroğlu (2018) also examined the competencies of secondary school mathematics teachers to create activities suitable for mathematical modelling and apply them in the classroom. During the four-week training process, necessary information about mathematical modelling, the characteristics of modelling activities, the creation of mathematical modelling activities and their application in the classroom was provided. The process of generating modeling activities posed significant challenges for the educators, with scarcely any of them demonstrating an ability to formulate activities that adhered to the prescribed principles. In Şahin's investigation (2019), an assessment was made of the competencies of mathematics teachers concerning the development of mathematical modeling problems. This evaluation was accompanied by structured training modules focusing on the introduction of mathematical modeling, the cognitive analysis of mathematical modeling problems, and considerations pertinent to problem formulation. After the training, teachers were asked to prepare activities. The results showed that although the teachers performed successfully in the process of preparing mathematical modelling activities, they experienced some difficulties. In these studies, teachers were given theoretical information about the concepts of mathematical models and modelling and the characteristics of modelling problems and their skills in preparing modeling problems were measured. As a result of the findings, it was concluded that teachers had difficulty in designing modelling activities. It can be concluded that teachers' level of knowledge about mathematical modelling increased in the training given to prepare mathematical modelling problems, but they had difficulties in preparing their own problems. This study is different from other studies in that it was carried out by providing mathematical modelling training to secondary school mathematics teachers in the process of preparing mathematical modelling activities as well as their active participation in modelling activities. Since teachers' participation in modeling activities and solving modeling problems will contribute to their modeling competencies, it is thought that it will also make a difference in their competencies in preparing modeling problems. In this respect, this study conducted with secondary school mathematics teachers is not only contains theoretical information provided teachers but also provides a learning environment in which teachers can improve their modeling competencies. So, this study will support previous studies.

Purpose of the Study

Thus, this study aims to examine the changes in the mathematical modelling activity preparation competencies of secondary school mathematics teachers who participated in mathematical modelling training. The sub-problems based on this purpose are as follows.

1. What are the competencies of secondary school mathematics teachers in preparing mathematical modeling activities before receiving mathematical modeling training?

2. What are the competencies of secondary school mathematics teachers in preparing mathematical modeling activities after receiving theoretical training on mathematical modelling?

3. What are the competencies of secondary school mathematics teachers in preparing mathematical modeling activities after receiving practical training on modelling?

Method

Research Design

In this study, the action research method, one of the qualitative research methods, was used. Action research is a research process carried out in a classroom or school environment to determine and improve the level of actions and teaching (Johnson, 2012; McKernan, 2008; McTaggart, 1997). The aim of action research is not only to collect and make sense of information about the relevant environment but also to develop information about the practices of a particular environment (McKernan, 2008). From this point of view, researchers should make various interventions in the environment. In this study, rather than investigating the competencies of secondary school mathematics teachers to prepare mathematical modelling activities, the development of their competencies to prepare modelling activities was monitored by designing learning environments in line with two action plans.

Action plans. First of all, a semi-structured knowledge scale about mathematical models and modeling was administered to teachers. Then, they were asked to prepare a modeling problem. According to the data, it was determined that teachers' modeling definitions were incomplete and they had problems in preparing modeling problems. In the endeavor to devise a suitable modeling problem, the foundational prerequisite entails a comprehensive internalization of the concept of modeling. Consequently, the initial action plan was set into motion, entailing the provision of instructional sessions that imparted theoretical insights into the domain of mathematical modeling. Instances of analogous pedagogical interventions are documented in extant scholarly literature. Subsequent to this training, an evaluative reassessment was conducted to gauge the teachers' proficiencies in crafting modeling problems. It was concluded that these competencies improved but were still not at a sufficient level. The next action plan is to design a learning environment to support teachers' active participation in mathematical modelling activities. In this practice, teachers solve modelling activities as a group and share their results. At the end of the application, teachers' competencies in preparing modelling activities were measured and the action plans were finalized. Information about the application process is presented in Figure 1.

Figure 1.

Application process of the study
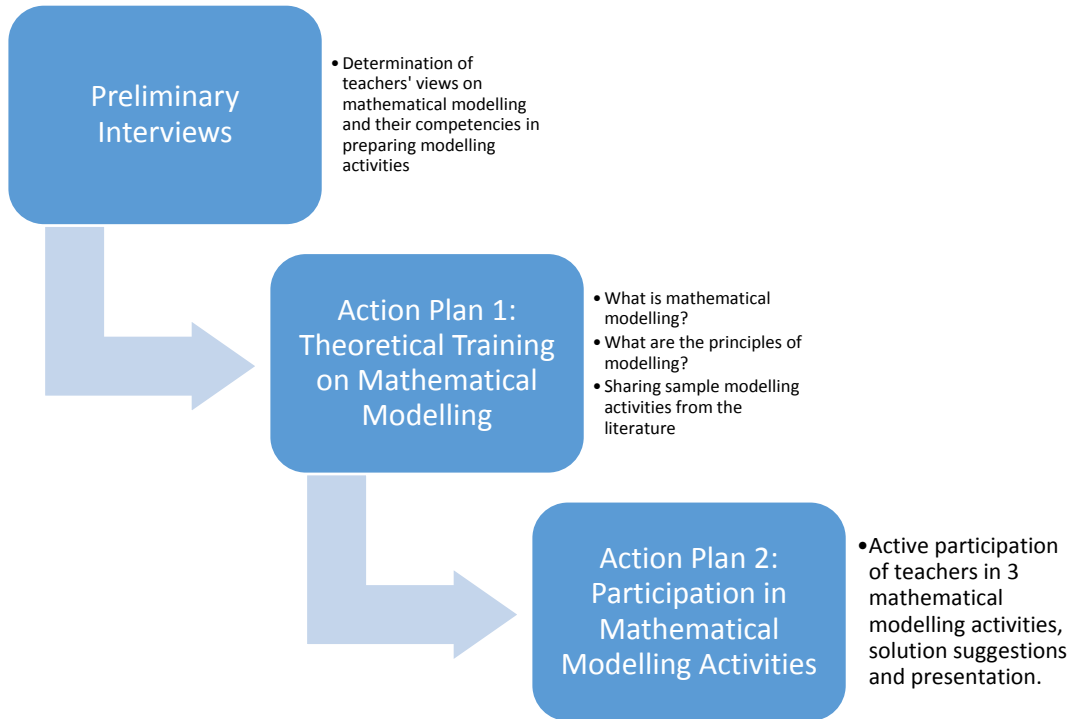
The application process of the study is summarised in Figure 1. Action research stages were taken into consideration in the realisation of these stages. As a result of the analyses made at the end of each application, the next action plan was decided.

Study Group

In this study, the convenience sampling method was used. The researcher turns to the easiest items he/she can reach to select the participants in this method (Yıldırım & Şimşek, 2013). It is known that researchers conducting qualitative studies often prefer situations that are easy and not expensive to study. The study group consisted of 6 secondary school mathematics teachers working in secondary schools in the centre of a medium-sized province in the 2020-2021 academic year. Before the study, the teachers were informed about the study and their voluntary participation was ensured. Since the study involves a long-term application, it is important that the participants are both accessible and voluntary. In the application, teachers were coded as T1, T2, ... and the demographic information of the teachers is presented in Table 1.

Table 1.

Demographic information of the teachers

Teachers	Gender	Professional Experience	Education Status
T1	F	16	MD
T 2	F	19	MD
T 3	M	8	MD
T 4	F	9	MD
T 5	F	16	MD
T 6	F	19	BD

According to Table 1, the study group consists of 6 secondary school mathematics teachers, 5 female and 1 male, working in secondary schools. Two of the secondary school mathematics teachers have 5-10 years of professional experience and the others have 15-20 years of professional experience. In the study group, there is 1 teacher with a bachelor's degree and 5 teachers with a master's degree.

Research Instruments and Processes

During the data collection process, teachers were asked to prepare mathematical modelling activities before the training, after the theoretical training and after their participation in the learning environment. The modelling activities prepared after each activity were examined using the mathematical modelling activity evaluation form. This form is presented in the data analysis section. Written documents were collected for the mathematical modelling problems prepared by the teachers. Throughout this procedure, the instructional sessions were meticulously recorded as a potential resource for future reference; however, it is noteworthy that these recorded meetings were not employed as a primary data source. These training sessions were elucidated with the aim of acquainting individuals with the educational milieu in question.

Training meetings. In training meetings, theoretical information about mathematical modelling is given and mathematical modelling problems are solved in group dynamics. In the first stage of the meetings, training on mathematical model and modelling, the mathematical modeling cycles, the characteristics of modelling activities, and the principles of mathematical modeling problems was given to the teachers. In addition, mathematical modelling examples in the literature were shared. In the second stage, mathematical modelling examples were solved with group work. The mathematical modelling problems solved are 1st Water sprayers (Bukova Güzel, 2016), 2nd Let's Build Environmentally Friendly Buildings with Pet Bottles (Gürbüz & Doğan, 2018), 3rd Water Purifier or Carboy? (Ural, 2018). In the training meetings, while solving the examples with group interaction, the opportunity was provided for the internalisation of mathematical modelling and the solved example was compared with the prepared example and evaluated. At the end of the activities, teachers were asked whether they would revise the modeling problems. All trainings were carried out on the online platform. The researchers guided these learning environments.

Data Analysis

In this study, which was conducted to examine the competencies of secondary school mathematics teachers in preparing mathematical modelling activities, the descriptive analysis method was used to analyse the data obtained

from interviews and written documents (Yıldırım & Şimşek, 2013). Yıldırım and Şimşek (2013) defined descriptive analysis as the classification and interpretation of the data collected according to the themes determined before the study. In descriptive analysis, the data are classified according to the pre-specified themes and the findings related to these data are summarised and interpreted by the researcher. In this study, the activities prepared by the teachers were coded and analysed. For example, the first activity of T1 is shown as T1.1, the second activity of T1 is shown as T1.2 and the third activity of T1 is shown as T1.3. In the first stage of the descriptive analysis, the conceptual framework of the study was established and the categories under which the obtained data would be analysed were determined. In this context, data analysis was carried out according to Wess et al. (2021), principles of preparing mathematical modelling activities. The activity evaluation form prepared in accordance with these criteria is explained below:

Mathematical modelling activity evaluation form

This form was used in the study to determine the qualities of mathematical modelling activities created by secondary school mathematics teachers. To fulfill this objective, specific criteria derived from the foundational principles governing the preparation of mathematical modeling problems were adopted, as delineated by Wess et al. (2021). These criteria encompass reference to reality, relevance, authenticity, openness, and sub-competencies associated with modeling. A comprehensive elaboration of these criteria, along with their corresponding indicators, can be found in Table 2.

Table 2.

Criteria and indicators for modelling problems according to Wess et al. (2021)

Criteria	Indicators
Reference to reality	The mathematical modelling activity has a non-mathematical, realistic, and factual starting point.
Relevance	Mathematical modelling activity is closely related to the student's environment or real life.
Authenticity	Authenticity in the sense that the mathematical modelling activity is a real problem of individuals, and the results are used in concrete situations.
Openness	Mathematical modelling activity has different solutions and allows different levels of approach.
Modelling sub-competencies	The mathematical modelling activity provides the cognitive competencies in the steps of the mathematical modelling cycle.

Considering the criteria and indicators in Table 2, the principles can be explained as follows (Wess et al., 2021): The reference to reality criterion states that the problem situation should be a situation that exists in real life. The problem situation has a non-mathematical factual reference. The relevance criterion reveals that the problem situation should be closely related to the students' experiences. This closeness does not require students to be directly related to the problem situation. The problem situation can be directly, indirectly or in the future related to the students. Authenticity criterion refers to both the inclusion of a non-mathematical context in the problem situation and the application of mathematics in the given situation. The non-mathematical context should be real and not specifically designed for a particular traditional problem. The application of the results obtained in this context should also be realistic and should not be used only in mathematics lessons. Authentic modelling problems should

belong to a subject that really exists, and their results should be acceptable to people working in these fields (Niss, 1992). The openness criterion is that the problem situation allows more than one approach or solution. Not giving all the data related to the problem in the problem statement enables students to exhibit different approaches during the solution. In the criterion of Modelling sub-competencies, it is important that the problem situation develops the sub-competencies of modelling, and this problem should encourage the development of modelling competencies in the modelling cycle. It is found that most of the mathematical modelling activities prepared in parallel studies in the literature are examined in line with the principles put forward by Lesh et al. (2000). However, the mathematical modelling activities prepared in this study were examined in accordance with the criteria prepared by Wess et al. (2021). One of the original aspects of this study is the introduction of these criteria.

The activity prepared by the teacher coded T1 for sample analysis is presented in Figure 2.

Figure 2.

The activity prepared by the teacher coded T1.

> Due to the epidemic disease, schools had to conduct their education remotely. Zeynep cannot attend distance education classes because she does not have internet at home. Her family decided to connect the internet so that Zeynep could attend live lessons and her education would not be disrupted. In order for Zeynep to attend her classes, 16 GB of internet is required.
>
> Zeynep's family has two options for internet connection:
>
> 1st Option: 1 GB internet with GSM operators is 7TL.
>
> 2nd Option: 1 GB internet with a fixed telephone line is 5,8 TL. However, in order to establish an internet connection with a fixed telephone line, they need to buy a telephone device for their home.
>
> In your opinion, which option would be logical for Zeynep's family to choose, explain the reasons.

The analysis of the activity prepared by the teacher coded T1 presented in Figure 2 according to the criteria given in the evaluation form is given in Table 3.

Table 3.

Evaluation of the mathematical modelling activity prepared by teacher T1 according to the criteria

Criteria	Suitable	Partly Suitable	Not Suitable
Reference to reality	√		
Relevance	√		
Authenticity			√
Openness		√	
Modelling sub-competencies		√	

When Table 3 is analysed, the reference to reality criterion is that the problem situation has a non-mathematical factual reference. In this context, the problem situation is deemed entirely congruent with the reality criterion, as it can feasibly manifest in real-life scenarios. Similarly, the problem situation's ability to establish a meaningful connection to the students' personal experiences renders it in alignment with the relevance criterion. Authenticity refers to the application of both the non-mathematical context in the problem situation and the application of mathematics in this particular situation. The context of the problem situation is realistic but not authentic because it is expressed in terms of fictionalised numbers. Openness means that the problem situation allows more than one approach or solution. From this point of view, the fact that some values are given in the problem situation shows that it partially complies with the principle of openness since it will limit the solutions. From the same point of view, since the options are limited, it does not direct the students to the model creation step. Rather, it encourages students to obtain a mathematical result. Thus, it is seen that the prepared activities are partially suitable for the sub-competencies criteria.

Validity and Reliability Studies

One of the ways to increase internal validity in the study is to benefit from expert suggestions regarding different stages of the study (Yıldırım & Şimşek, 2013). In the process of selecting the mathematical modelling activities included in the study, the modelling problems were checked structurally by an instructor and necessary changes were made in line with the expert opinion. Thus, it was tested whether all modelling problems provided the modelling principle. At the same time, expert opinion was consulted in the evaluations regarding the Mathematical Modelling Activity Evaluation Forms prepared for the teachers' activities. The researcher's long-term interaction with the study is another method used to increase internal validity. What is meant by long-term interaction is to spread the interaction between the researcher and the data source over a long period of time in order to further increase the credibility of the data obtained. Since this study lasted 8 weeks, it can be considered as a long-term study. External validity (transferability) is related to the extent to which certain findings obtained from a study can be adapted to similar situations provided that the meaning and inferences are preserved (Arastaman et al., 2018). Transferability is ensured by the detailed description method used in qualitative studies (Yıldırım & Şimşek, 2013). In order to strengthen the transferability of this research, data collection tools and the entire data collection process were explained in detail. In this study, direct quotations were included in the activities prepared by the teachers in order to be as faithful as possible to the nature of the data and to set an example.

One of the ways to increase internal reliability is the role of the researcher. In the study, the researcher plays a role as the person who plans the teaching environment and manages the process with the practitioner. The researcher participated in the teaching environment one-to-one and supported the teachers in developing their competencies in preparing mathematical modelling activities by making necessary interventions both in the information meetings and in the training meetings where the mathematical modelling activities were solved. For internal consistency, the mathematical modelling activities prepared by the research group were evaluated by the researcher and an expert in accordance with the indicators.

Results

Table 4 shows the information about the conformity of the activities designed by the teachers before receiving any training on mathematical modelling with the principles in the evaluation form.

Table 4.

Examination of modelling problems created by teachers before the application according to the criteria

Teacher	Criteria	Reference to reality	Relevance	Authenticity	Openness	Modelling sub-competencies	Completely Suitable
T1.1	Suitable	√	√				
	Partly Suitable				√	√	X
	Not Suitable			√			
T2.1	Suitable						
	Partly Suitable						X
	Not Suitable	√	√	√	√	√	
T3.1	Suitable						
	Partly Suitable	√					X
	Not Suitable		√	√	√	√	
T4.1	Suitable	√					
	Partly Suitable						X
	Not Suitable		√	√	√	√	
T5.1	Suitable	√		√	√	√	
	Partly Suitable						X
	Not Suitable		√				
T6.1	Suitable						
	Partly Suitable						X
	Not Suitable	√	√	√	√	√	

As can be seen in Table 4, three of the six teachers presented activities in accordance with the reference to reality principle. The teachers tried to associate the activities with real life, but they did not pay attention to the students' experiences. In this context, it was observed that no activity was prepared in accordance with the relevance principle except for one activity. Correspondingly, the empirical observations revealed a notable scarcity of activities that adhered to the principle of authenticity, with only a solitary activity found to align with this particular criterion.

Again, except for one teacher, there was no modelling activity that adequately met the criteria of promoting openness and sub-competencies. As a result, when all criteria were evaluated together, it was seen that a modelling activity that met all of them was not developed. For example, the activity prepared by the teacher coded T2 is given in Figure 3.

Figure 3.

The first activity prepared by teacher T2.

$$Find\ the\ result\ of\ the\ operation\ \frac{3}{4}\ x\ \frac{2}{5}\ by\ modelling.$$

While it was determined that the problem prepared in Figure 3 was not suitable for any of the mathematical modelling criteria, it is noteworthy that this problem was prepared in the context of modelling mathematics. It was observed that three of the other five activities were classical verbal problems that were tried to be associated with daily life.

The mathematical modelling activities prepared by secondary school mathematics teachers after receiving training in mathematical modelling were examined to answer the question "What is the level of competencies of secondary school mathematics teachers in preparing mathematical modelling activities after receiving training on mathematical modelling?". When the process after the information meetings was examined, it was seen that teachers coded T1 and T3 did not revise the mathematical modelling activities they had prepared, while other teachers prepared new activities. The findings related to this sub-problem are presented in Table 5.

Table 5.

Examination of the modelling problems created by the teachers after the information meetings according to the criteria

Teacher	Criteria	Reference to reality	Relevance	Authenticity	Openness	Modelling sub-competencies	Completely Suitable
T1.2	Suitable	√	√				
	Partly Suitable				√	√	X
	Not Suitable			√			
T2.2	Suitable						
	Partly Suitable						X
	Not Suitable	√	√	√	√	√	
T3.2	Suitable						
	Partly Suitable	√					X
	Not Suitable		√	√	√	√	
T4.2	Suitable	√					
	Partly Suitable						X
	Not Suitable		√	√	√	√	
T5.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						

Teacher	Criteria						
T6.2	Suitable						
	Partly Suitable						X
	Not Suitable	√	√	√	√	√	

As can be seen in Table 5, after the theoretical training, only T5.2 is the only activity that is completely suitable for the criteria. The other five activities were partially suitable or not suitable with the criteria. From this point of view, it was determined that the information meetings alone were not sufficient to improve the preparation of mathematical modelling problems.

The mathematical modelling activities prepared by the teachers after their active participation in the mathematical modelling activities carried out following the information meetings were examined in order to answer the question "What is the level of secondary school mathematics teachers' competencies in preparing mathematical modelling activities after receiving training on mathematical modelling?". Throughout this process, it was discerned that all educators, with the exception of T1 and T5, engaged in the process of revising and enhancing their originally conceived activities. Detailed insights into the conformity of these post-training activities with the established principles are presented in Table 6.

Table 6.

Examination of mathematical modelling activities prepared by teachers after participation in modelling activities according to criteria

Teacher	Criteria	Reference to reality	Relevance	Authenticity	Openness	Modelling sub-competencies	Completely Suitable
T1.2	Suitable	√	√				
	Partly Suitable				√	√	X
	Not Suitable			√			
T2.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						
T3.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						
T4.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						
T5.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						
T6.2	Suitable	√	√	√	√	√	
	Partly Suitable						√
	Not Suitable						

As can be seen in Table 6, after the activity solutions, the activities that fully fulfil the criteria are T2.3, T3.3, T4.3, T5.3 and T6.3. Only the T1.3 activity partially fulfils the criteria of authenticity, openness, and modelling sub-competencies. Based on the findings, it was determined that the learning environment designed to improve

mathematical modelling problem preparation was significantly more effective than the information meetings. An example of the modelling activity prepared by the teacher coded T3 after the activity solutions is given in Figure 4.

Figure 4.

The third activity prepared by teacher T3.

Residents of Fatih neighbourhood in Erzincan have observed that there are accidents and chaos on the street they often use because there is no traffic light. A group of students who applied to the Traffic Branch for a traffic light at the junction where Terzibaba Street and 700th Street meet, submitted a document to the Traffic Branch about what they should observe until they made this application and why they wanted a traffic light. Explain how you would help these students by sending a letter.

This activity prepared by the teacher coded T3 in Figure 4 was prepared in accordance with all modelling criteria. It was determined that the activity reflected a problem in the province where the teachers were located, and the information given was realistic and authentic. In addition, it is an open-ended activity related to the close environment of the students. It was also seen that it encouraged modelling competencies. Similarly, the example of the modelling activity prepared by the teacher coded T4 after the activity solutions is given in Figure 5.

Figure 5.
The third activity prepared by teacher T4.

CONCRETE ROAD OR ASPHALT ROAD?

Roads, which constitute an important part of the infrastructure elements of a nation, are one of the important indicators that the nation has a civilisation. To the extent that transport is easy and convenient in a country, science and art can develop to the same extent. Therefore, roads should be given importance in order to ensure easy transport and the development of social welfare.

Concrete roads are more durable and environmentally friendly than asphalt roads. On the other hand, when the slipping of vehicles in snowy weather conditions is considered, asphalt roads have a safer structure. Considering that asphalt is a petroleum derivative, the fact that concrete is produced with domestic raw materials in relation to increasing oil prices makes concrete roads advantageous compared to asphalt in the initial construction cost. However, since asphalt is not a reactive substance like concrete, asphalt roads require less maintenance.

In line with this information, we are asked to determine whether the construction of concrete roads or asphalt roads is more advantageous and to explain what we have taken into account in reaching this conclusion.

It is seen that the activity given in Figure 5 complies with all principles. It can be claimed that the activity given above is suitable for the reference to reality principle because it reflects the situations that exist in real life. It is seen that it is suitable for the principle of relevance because it is directly or indirectly related to the student's life; it is suitable for the principle of openness because it allows different approaches, and all data are not given in the problem. Likewise, the fact that it expresses mathematical applications in both non-mathematical contexts and special cases shows that the activity complies with the principle of authenticity. Since the options are not limited, it is seen that they encourage modelling sub-competencies.

Discussion, Conclusion & Suggestions

In this study, which aimed to examine secondary school mathematics teachers' processes of preparing mathematical modelling problems, the following results were obtained:

It was observed that the activities designed by half of the teachers before the training meetings were suitable with the reference to reality principle. However, while preparing the activities, teachers did not pay attention to the fact that they were related to students' experiences. This finding of the study is similar to the results obtained by examining the mathematical modelling activities prepared in the studies conducted by Dede et al. (2017) with prospective mathematics teachers and Şahin (2019) with mathematics teachers. This result is also consistent with the studies of Borromeo Ferri and Lesh (2013). It was evident that the activities formulated based on pre-existing knowledge exhibited significant incongruities with respect to the principles of openness, relevance, authenticity, and modeling sub-competencies. In light of these findings, it can be claimed that teachers' initial competencies in preparing mathematical modelling problems are low. This result coincides with the results of many similar studies in the literature (Bilgili et al., 2020; Dede et al., 2017; Deniz & Akgün, 2016; Stohlmann et al., 2017; Yu & Chang, 2009). Since mathematical modeling skills have just entered the curriculum (MoNE, 2017), many of the teachers may not have received training or knowledge on this subject.

The teachers' modeling problems after their mathematical modelling training were examined. When the activities prepared at the beginning of the process were compared with the activities prepared during the process, it was observed that the number of activities prepared suitable with the principles gradually increased. However, it was still observed that they could not prepare activities suitable with all criteria. From this point of view, it is concluded that there are deficiencies in preparing activities in accordance with all criteria based on prior knowledge or theoretical training about mathematical modelling. This finding overlaps with the results of many similar studies (Bilgili et al., 2020; Dede et al., 2017; Stohlmann et al., 2017). Similarly, in the studies conducted by Sağıroğlu (2018), Deniz (2014) and Şahin (2019), it was observed that teachers had difficulties in the process of creating modelling activities even after the training. This may be due to the fact that teachers have not encountered modelling activities before (Korkmaz, 2010; Urhan & Dost, 2016). In this study, teachers were exposed to mathematical modelling activities after the information meetings. Teachers' active participation in modelling activities positively affected their competencies in preparing mathematical modelling activities and it was determined that they were generally able to prepare activities in accordance with the principles. In conclusion, it can be posited that the teachers' competencies in the development of mathematical modeling activities have shown discernible enhancement, attributable to their

active involvement in mathematical modeling tasks and their attendance at informational sessions dedicated to mathematical modeling. Previous studies show that after participation in mathematical modelling activities, there are positive differences in the understanding of the activities (Korkmaz, 2010; Shahbari, 2017).

When the activities prepared during the process are analysed in principle, it is seen that they were first tried to be prepared in accordance with the reference to reality principle and to some extent they could be prepared in accordance with this criterion. These findings are in line with the studies conducted by Deniz and Akgün (2016), Bilgili and Çiltaş (2022), Dede et al. (2017), Deniz (2014), Şen (2020), Şahin et al. (2023). In fact, it can be expressed that the criterion that teachers pay the most attention to when preparing mathematical modelling problems is the real-life situation because the prepared problems are suitable for real life even if they are not mathematical modelling activities. As in the studies of Deniz and Akgün (2016), Bilgili and Çiltaş (2022), Dede et al. (2017), Şahin (2019) and Şen (2020), it is found that the reference to reality principle plays a binding role in modeling problems. In fact, teachers are used to real-life problems in their classes. For this reason, they may have taken this criterion into consideration first. The reality criterion is important but not sufficient for modeling problems.

One of the most prominent features of mathematical modelling problems is that they are based on assumptions and preferences (Lesh & Doerr, 2003). This feature of the problem is that it allows more than one approach or solution for the solution. This feature, which is considered as the principle of openness in this study, can also be considered as the problem being open to interpretation. Not giving all the data in the problem statement allows students to exhibit different approaches during the solution. For this reason, it is important that the problem sentence is open-ended. The findings obtained show that most of the teachers were not sufficient in this regard before receiving training. However, when the problems prepared during the training process were evaluated, the most important criteria for all teachers after the reference to reality principle were the relevance and the openness principle. Deniz (2014) and Şen (2020) reached the same conclusion in their study. However, it was observed that some teachers gave some numerical data required for the solution of the problem not as a single value but as an interval. From this point of view, it can be expressed that some teachers perceive the ability to use the desired numerical values within a certain range as using different variables, and the fact that the numerical results of the solutions are different as different models. These results are similar to Şahin (2019)'s study. This situation may stem from the existing education system's habits.

Another criterion for mathematical modelling problems is their authenticity. Authentic modelling problems belong to an existing subject or problem area and are accepted by people working in these areas (Niss, 1992). When the problems prepared in the process are analysed, it is seen that the authenticity principle is provided at least in the problems prepared at the beginning of the process. In the problems prepared at the beginning of the process, the non-mathematical context is not real and is specially designed for a specific arithmetic problem. In the problems prepared as the process progresses, it is seen that the principle of authenticity is largely fulfilled.

Another important feature of mathematical modelling problems is that they promote the sub-competencies of mathematical modelling. It is important that the problem situation develops the sub-competencies of modelling, and this problem should encourage the development of modelling competencies in the modelling cycle. When the

prepared problems were analysed, it can be expressed that activities were prepared in accordance with this principle, especially as the process progressed. This result coincides with the results of Deniz and Akgün (2016), Dede et al. (2017), Deniz (2014) and Şen (2020). It contradicts the result of Bilgili and Çiltaş (2022) and Şahin et al. (2023), according to their study this principle is the most ignored one. Although only model creation and model generalization criteria are taken into account in these studies, teachers do not develop problems in accordance with these criteria. This difference may be due to the different modeling problem criteria taken into consideration in the studies. In this study, the new criteria proposed by Wess et al (2021) were taken into account.

In the study, it was determined that teachers' competencies in preparing modelling problems was low. In order to complete these deficiencies, it is recommended to design environments for the development of teachers' modelling competencies as well as theoretical training. In this study, the learning environment includes both theoretical knowledge and the application of modelling activities to teachers. By designing different learning environments, teachers' competencies to develop activities for modelling can be examined. New ideas about which environment will be used in practice can be put forward. In addition, the new criteria for modelling problems expressed in this study can guide teachers in developing or selecting modelling problems. This study is limited to four modeling problems applied during training. The results can be tested by applying different and more problems. In the study, training meetings were applied in an online environment. The outcomes derived from this investigation are circumscribed within the confines of online training. Thus, it is required to consider the potential variance and commonalities that may emerge in a face-to-face learning environment. Furthermore, the study uncovered that one of six teachers continued to encounter challenges in formulating modeling problems despite the training. This prompts further examination into the underlying reasons for the resistance demonstrated by certain teachers in the context of mathematical modeling.

Ethic

According to the decision of Erzincan Binali Yıldırım University Educational Sciences Ethics Committee, dated 26/02/2021 numbered 66253, this study received ethical approval.

Author Contributions

This research is derived from the first author's master dissertation conducted under the supervision of the second author.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Ihsan Hilmi Alantar and Child Welfare in Early Republican Türkiye

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Abstract

The late 19th and early 20th centuries witnessed an unprecedented global spread of the desire for healthy and large populations in modern nation-states. This desire was associated with the principle of patriotism and integrated into health policies. An obsession with increasing the vitality of the social and political body was influential in shaping these health policies. Simultaneously, this period also witnessed the dissemination and adoption of scientific concepts and discourses such as child welfare, eugenics, child culture and hygiene. In the young Republic of Türkiye, founded after a devastating ten-year war and grappling with concerns about population growth, these discourses were swiftly embraced and became part of the "scientific" literature. These discourses were advocated mainly by a cadre of elitist Republicans who aimed to position Türkiye among modern nations. Among these elites was İhsan Hilmi Alantar, who opened Türkiye's first children's clinic. This article delves into Alantar's views, endeavours, and actions in the realm of child welfare, set against the backdrop of the historical milieu of the era.

Key Words

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Introduction

The evolution of child welfare, and social welfare in general, has been explained in diverse manners throughout history. Prior to the late 1960s, scholars commonly described the relationship between children and the state as characterized by a growing sense of humanitarianism, an increasing concern for underprivileged youngsters, and an incremental shift from the harsh conditions of pre-and early industrialization to the more compassionate and reliable approaches of the contemporary welfare state. The main reason for this was the empathy shown by doctors, spiritual leaders, state officials, administrators, politicians, and society towards impoverished, vulnerable, innocent children. However, as critical social science literature gained prominence in the 1970s, it became increasingly challenging to maintain such a simplistic and innocent perspective on the history of social welfare (Krieken, 1986, p. 401). As cited Krieken (1986, p. 402), the turning point for child welfare in histography was Anthony Platt's "The Child Savers" (1969). Platt (1977) revealed that the reason for the emergence of child welfare was not the philanthropic feelings of states or society. In fact, they were driven by political, economic, and social goals such as training better-disciplined workers, preventing and combating crime, raising hard-working and self-reliant citizens, establishing a desirable morality, and increasing the population. Since this pioneering work, a growing body of research has enabled us to think more deeply and more realistic about child welfare.

In the latter part of the 19th century, with the rise of the nation-states and militarism, child welfare evolved from focusing primarily on rescuing, reforming, and rehabilitating children to actively involving children in a deliberately planned effort to serve the national interest. This broader scope encompassed aspects such as overall efficiency, public health, education, racial hygiene, responsible parenthood, and social purity. Children were given a new social and political identity as belonging to "the nation" (Hendrick, 2008, p. 19). During this era, similar to nearly all states worldwide, the Ottoman Empire, which preceded the Republic of Türkiye, also joined in this trend. In the 1830s, a large and robust population was deemed a critical prerequisite for economic growth, and this circumstance placed thinking in the Ottoman Empire on a par with central European ideas on the relationship between population increase and economic revitalization. Around the mid-19th century, the Ottoman state came to reckon and categorize "population" as having an economic utility or as an essential source of wealth, if not the most important in a milieu. Then, the Empire increased its sensitivity to the demands and needs of the population (Dursun, 2011, p. 163).

Ottoman politicians, scientists, intellectuals, and medical professionals agreed that the population was a pivotal asset for national wealth and a fundamental prerequisite for prosperity and advancement. They expressed concerns, however, that the Muslim population was experiencing significantly slower growth compared to non-Muslim groups, particularly the Christians within the Empire. Consequently, they advocated for immediate legal, medical, and institutional measures and initiated comprehensive policies to foster higher population growth rates and address the obstacles hindering such growth. The population garnered increasing attention as a critical national resource during this period. Simultaneously, the Ottoman state grappled with substantial population losses due to territorial concessions, nationalist uprisings, the emergence of independent states, extensive migration movements, and epidemics (Balsoy, 2013, p. 5). The outbreak of the Balkan Wars during this period intensified the situation, plunging the country into a tumultuous environment that would persist for a decade with the First World War and the

War of Independence. The Republic of Türkiye, which emerged from this extended period of upheaval, adopted and implemented the population and health policies inherited from the Ottoman Empire with a more pronounced emphasis on radical and systematic measures.

The child occupied a central position in the health policy of the Republic of Türkiye. This child-focused discourse was evident in the writings of nearly all doctors during that era. The primary driving force behind this focus can be attributed to the significant loss of the middle-aged population during the war. However, the modernist objectives of the Republican elites were such that they necessitated a rebuilding effort, and the avenue to achieve this was through the children.

The founding elites of the Republic came from a generation that had directly experienced the repercussions of economic dependence on external forces. Their primary goals included the development of a national economy, fostering economic growth, and initiating a national industrialization process. They knew that achieving these goals necessitated a robust workforce. Besides, the looming shadow of the Second World War underscored the imperative of establishing a self-reliant national economy and a war industry. It also highlighted the importance of a healthy and robust military force and the requirement for educated and strong soldiers. Furthermore, in shaping the modern nation-state that the founding elites envisioned, they needed citizens who felt a deep sense of belonging to the state, nation, and land (Arpacı, 2015, p. 7). These citizens were expected not to burden the state but to actively contribute to it, increasing production and population. These aspirations could only be realized with a large and healthy population. So, the child was portrayed as a resource, reservoir and source of hope for the nation-state (Libal, 2016, p.51). The debates regarding population and children's welfare during this period were framed as national issues to be addressed by the larger society and the Turkish state. A professional sector dedicated to child welfare emerged in parallel with the widespread discourse on population and nation-state building. These professional elites typically asserted their involvement for "humanitarian" reasons tied to the nationalist and modernist initiatives of the early Republic. By ensuring the well-being and survival of the children under their care, doctors, nurses, social workers, teachers, and other volunteers portrayed themselves as contributors to the fledgling nation-state (Libal, 2000, pp. 57-58). Among these individuals was Ihsan Hilmi Alantar, one of Türkiye's earliest paediatricians. This article delves into Alantar's views, endeavours and actions in the context of child welfare in early Republican Türkiye, set against the historical backdrop of the period.

Method

The present study adopts historical research approach to scrutinize the views, endeavours and actions of Ihsan Hilmi Alantar in child welfare. Historical research is a qualitative research method that involves the exploration and interpretation of events and phenomena from the past. Historians employ a systematic and disciplined approach to uncover historical developments, shifts, and interactions that have shaped our world over time. Central to historical research is using primary sources, consisting of original materials from the specific period under examination. These sources offer an authentic window into the past, serving as the cornerstone for rigorous examination and analysis. The ultimate objective of historical researchers is to reconstruct events and attain a profound understanding of the

motivations and contexts that drove historical figures and actions (Gottschalk, 1969; Hexter, 1971; Mallick & Verma, 2005; Muratovski, 2022).

The fundamental source materials for this research consist of Ihsan Hilmi Alantar's literary works, including his books, articles, and contributions to newspapers.. Furthermore, a scrutiny of primary sources of the era and scholarly literature shall be undertaken to elucidate his perspectives within the contextual milieu.

Results

A Short Biography of Ihsan Hilmi Alantar

Ihsan Hilmi Alantar was a prominent paediatrician and social reformer in late nineteenth and early twentieth-century Türkiye. Born in Istanbul in 1888, he received his primary education at Çeşme Square School (Çeşme Meydanı Rüştiyesi) and secondary education at Vefa High School (Vefa İdadisi). Then, he studied medicine at the Imperial School of Physical and Medical Sciences (Mekteb-i Tıbbiyye-i Şâhane) and graduated first in 1911. Due to his first rank, 35th and penultimate Sultan Mehmed Reşat awarded him a gold watch. Right after graduating, he began work in organic chemistry for eight months. Then, he started in general practice as an internal medicine assistant with Professor Fevzi Pasha and his assistants Neşet Ömer [İlderp] Bey and Adnan [Adıvar] Bey. During the onset of the Balkan War in 1912, he worked as a medical doctor at the cholera centre in Hadımköy. Regrettably, he contracted typhus while there and struggled to overcome the illness. After his discharge, he passed the competitive examination for paediatrics specialist and went to Paris. Here, he worked for a year with Professor of paediatrics Victor Henri Hutinel. With the start of the First World War, he returned to his country and was taken into military service with the rank of lieutenant. He worked as a medical doctor first at Ayastefanos Hospital, then at the Red Crescent (Hilal-i Ahmer), in Konya, Beyoğlu, Gallipoli, Tekirdağ Hospitals, Suez, and Jerusalem During his two years in the army, he came to the attention of the army commander, Cemal Pasha. With Cemal Pasha's assistance, in 1916, he was sent back to Europe to further his expertise. This time, he went to Germany to work with Professor Adalbert Czerny, the founder of modern paediatrics and a believer in eugenics (Rado, 1948, p. 3; Soysal, 1960, pp. 1139-1141; Tümay, 1962, pp. 116-118). Alantar, worked with him for two years and was under the influence of Czerny's scientific thought.

After the war ended, he returned to Istanbul, participated in the National Struggle, and became a member of the Red Crescent. He served as the head of the Karamürsel health emergency unit for sixteen months and then went to Eskişehir. After the First İnönü Battle victory, he and his team went to Ankara and joined the Ministry of Health. Here, he worked as an internal medicine specialist at the Numune Hospital. In 1921, he opened the first children's clinic in Ankara. During this time, upon the order of the Ministry of Education, he wrote a textbook called "Child Care (Çocuk Bakımı)" to be taught in teacher training schools. After Ankara, he moved to Kayseri and opened Türkiye's second childcare centre. After the proclamation of the Republic in 1923, he returned to his hometown, Istanbul and was appointed as a paediatric specialist at Şişli Children's Hospital. In 1924, he became a lecturer in paediatrics at Darülfünun Medical Faculty. In 1933, he was appointed as the director of the Clinic for Child Diseases and Care, and in 1940, he became a professor-in-ordinary. He was elected to the United Nations World Health Organization Children's Committee in 1948. Until his retirement due to the age limit in 1957, he worked at

Darülfünun Medical Faculty (later known as Istanbul University Medical Faculty). He passed away on March 9, 1962 (Rado, 1948, p. 3; Soysal, 1960, pp. 1139-1141; Tümay, 1962, pp. 116-118).

Alantar's View and Efforts on Child Welfare

Neither the mother nor the father alone can ensure a child's proper upbringing. The government, cities, and charitable societies will do this, the ones busy with health. With a sense of pride and joy, we can affirm that this work has commenced, and with each passing year, we are taking increasingly clear steps toward progress in this endeavour. (Alantar, 1939a, p. 6)

With these words, in the Seventh National Medical Congress, Alantar articulated his pleasure, concerns and desires for the state to take comprehensive action to address child health issues. He, along with numerous other doctors, firmly believed that the state was responsible for guaranteeing child welfare. This duty was in line with the practices of modern states in Europe and the United States during that era. Turkish doctors shared the conviction that systematically tackling child welfare through state-directed and funded initiatives was a fundamental prerequisite for resolving child health challenges. As mentioned in the introduction, population policy served as the central theme of these concerns. The child was part of a broader public discourse on population and became inseparable from the concept of nation-state construction. Regarded as a future citizen, the child symbolized a nation-state advancing towards a path of prospective prosperity and greatness.

Bringing child welfare under state control meant that a large population could be controlled as desired. Alantar believed that the rise of a country would be possible with the development of economy and culture together and that this could only be achieved by the young population. According to Alantar's calculations, in the early 1940s, there were approximately 4 million young people aged 7-18 in the country, which was 22.2% of the country's population. He believed that this population, which he described as 'fresh school youth', would be old enough to serve the country as a soldier or a professional within ten to fifteen years and that if the right policies were implemented during this time, this population could carry the country to the desired point (Alantar, 1944b, pp. 1-2). As Alantar stressed, this was a matter that couldn't rely solely on families. Doctors of that era, harboured doubts about the general public's reliance on traditional, non-modern childcare methods. In the introduction of his book, Alantar (1949b, p. 7) underscored this concern with the statement, "knowledge about children should be known not only by us but also by the public. How many mothers do we come across outside who are following incorrect paths in the matter of feeding and educating their children and do not see the way to salvation." So, for him, it became imperative to bring public health under state supervision and find effective means to educate families about childcare. "Fortunately, the veil of old ignorance had been torn apart. The Republic government was now looking to the positive aspects of Europe and America as an example" (Alantar, 1949b, p. 7). In his speech when he was elected to the United Nations World Health Organization Children's Committee in 1948, he proudly described Türkiye's modern approach (Alantar, 1949a, pp. 11-15).

Another "modern" approach to child health and welfare during this period was eugenic discourse. Alantar, like several doctors of his era, held eugenicist beliefs. To him, a vital determinant of the optimal development of children's health was the racial background of their parents. According to him (1949b, p. 67; 1939b, p. 3), heredity

had a significant role in a child's physical and even spiritual development. He believed that "a newborn child is not a blank slate". To him, certain characters in the child are the legacy of their father. "Even if a character that a grandfather has does not exist in his son, it shows itself in his grandchild" (Alantar, 1949b, p. 67). These statements by Alantar align with the emerging ideas of degeneration, as proposed by the French psychiatrist Benedict-Augustin Morel in the mid-19th century. Morel contended that certain familial traits would increasingly manifest in children from that lineage (Carlson, 1985, p. 122). These concepts, further developed by Valentin Magnan after Morel (Prestwich, 1997, p. 116), were later coined as "eugenics" by Francis Galton at the end of the century. In 1904, Galton defined (1904, p. 1) eugenics as "the science which deals with all influences that improve the inborn qualities of a race; also, with those that develop them to the utmost advantage". Darwin's research on heredity and evolution had an impact on Galton. He thought that new scientific understandings could enhance the quality of human reproduction (Levine, 2017, p. 2). After Galton, eugenics became widely accepted and spread worldwide in a "scientific way". Due to a series of 'scientific' eugenics congresses conducted in the early 20th century (see Engs, 2005; Kühl, 2013), by 1922, government authorities were even able to assert with confidence that sterilization was an acceptable measure for addressing degeneracy. In 1922, "Eugenical Sterilization in the United States" was published by Harry H. Laughlin (1922), assistant director of the Eugenics Record Office in New York. A "model eugenical sterilization law" was presented in the book. Many European nations and states have adopted this model, such as Switzerland (1928), Canada (1928), Denmark (1929), British Columbia (1933), Sweden and Norway (1934), Finland and Danzig (1935), and Estonia (1936) (Engs, 2005, p. 54). The idea of sterilization was carried to a much more extreme point in Germany after the First World War. On July 14, 1933, The German government passed the "Law for the Prevention of Offspring with Hereditary Diseases" [Gesetz zur Verhütung erbkranken Nachwuchses]. The law allowed the coercive sterilization of anyone suffering from one of nine hereditary illnesses so as not to corrupt the German race (Lepicard, 2020, p. 141).

These eugenic ideas became interwoven with Alantar's medical education during his time in Germany. Alantar's mentor, Adalbert Czerny -denoted by Alantar as "my esteemed master"- delineated the tenets of social Darwinism within the domain of German pediatry, firmly embracing the principles of eugenics. Adalbert Czerny believed that "infant mortality is a selection; it befalls inferior constitutions" and rejected premature infants' special care (Obladen, 2021, p. 371).

Alantar was never as radical eugenicist as to leave premature babies to die as his mentor did (see Alantar, 1944a). However, he tried to connect a relationship between puericulture and eugenics. As stated earlier, Alantar gave a speech at the Seventh National Conference of Medicine in 1938. The conference's central theme revolved around eugenics, and Alantar's speech was explicitly intended to discuss and support eugenics within the context of paediatrics and child hygiene (Tunc, 2019, p. 42). In his speech, later published in booklet form, Alantar provided an expansive definition of eugenics. He cited heredity, gender, environment (including education), economic factors, social status, parental literacy, parental health, exposure to substances like alcohol, and lifestyles as primary factors influencing the quality of a population. According to him, these were crucial considerations both before and after procreation. He critiqued simplistic approaches that solely emphasized the hereditary aspects of eugenics, noting that classical eugenicists believed their work was complete when a healthy child was born to healthy parents. However,

Alantar argued that the reality was more complex. He contended that eugenics was especially significant after a child's birth, as the care given to a child post-birth determined whether they would thrive or degenerate in the future. This level of care was too important to be entrusted solely to families, and Alantar advocated for regular medical supervision of children until at least the age of two.

 Considering the scarcity of medical professionals in the country, Alantar's endeavor seemed ambitious. He was well aware of this situation, which prompted him to dedicate some of his time to crafting articles on childcare for newspapers (see Alantar, 1935; 1941a; 1941b; 1941c; 1941d; 1941e; 1941f; 1941g; 1942b; 1942c; 1942d; 1942e). Furthermore, he authored (1942a) a book titled "The Path to Proper Child Rearing: A Gift to Rural Mothers" for peasant women who lacked access to newspapers.

His book began with a simple yet impactful message:

Rather than going to your elderly neighbour, take your baby and go to the doctor immediately. Tell him your problem and listen carefully what he tells you. After you get home, do exactly what your doctor tells you. Then, your child will be strong and healthy. Everyone would tell you that: teach us how you care for your child. (Alantar, 1942a)

Its objective was to rescue village children from deeply entrenched traditional practices prevalent in the country, aligning with one of the primary objectives of the nation's leaders. He sought to heighten public awareness in his book by explaining every aspect, from children's attire and nutrition to sleep habits and physical exercise, using straightforward language. Nevertheless, given the low literacy rates in the provinces, it is likely that he was aware that this information only reached some of the population. So, he frequently emphasized the responsibilities of the government, municipalities, and charitable organizations in the realm of childcare, which he calls "social hygiene", and particularly concentrated on puericulture, the era with the highest child mortality rates.

Alantar (1949b) dealt with puericulture in two aspects. The first of these centred on the child's individual health, which covers issues such as the child's racial structure, nutrition, and physical development. The second was social health, which approaches the child from a social perspective. It reveals the child's role in the general population. It covers topics such as what government institutions could do to improve child health, reduce child mortality, and where social culture should evolve (Alantar, 1949b, p. 215). According to Alantar, both of these dimensions of puericulture aimed at enhancing not only the child's physical well-being but also their psychological health.

Alantar, like many medical doctors of his time, such as Besim Ömer Akalın, Fahrettin Kerim Gökay, Mazhar Osman Usman, and Kudsi Halkacı considered himself responsible for the nation's aspiration to raise future citizens to be healthy and contribute to society. He underlined (1944b, p. 2) his responsibility when he stated, "The fact that these children remain rotten, weak and neglected will leave us guilty throughout history". So, he sought to highlight, define and create modern social institutions and mechanisms to address child welfare and related social problems.

In his address at the Seventh National Conference of Medicine, Alantar emphasized the central role of the child in everything. He argued that social policies should prioritize children, as it was only through postnatal care that hereditary disorders in future generations could be prevented. In his view, the social hygiene of children constituted a vital policy. Furthermore, he deemed it even more critical for a nation like Türkiye, which had endured numerous

hardships and disasters (Alantar, 1949b, p. 12). As per his explanation (1949b, p. 215), social hygiene entails several vital aspects. Firstly, it involves educating parents and the public to enable them to provide proper individual childcare. Secondly, it focuses on safeguarding the health of children without parental support. Finally, it underscores the importance of monitoring children's growth and development. These responsibilities are shared by both government and philanthropic organizations, encompassing not only physical health but also mental well-being.

Indeed, child welfare encompasses a broad spectrum of concerns, including children's rights, neglect, child maltreatment, social inequalities, poverty, and related social issues. While Alantar addressed these significant problems, his primary focus was securing and monitoring children's individual health through state institutions and school health programs, and he saw these as the most critical elements of social hygiene.

In Alantar's view, two paramount imperatives included bolstering the birth rate and ensuring child survival. He articulated this perspective by stating (1949b, p.217), "Every child is capital; this capital belongs not only to the parents but also to the country. So, the child is a social capital." Consequently, he believed that the primary duty of the state and its institutions was to reduce child mortality. Alantar contributed to this mission as a paediatrician by examining and treating children. Additionally, he penned enlightening articles for the public, particularly in prominent newspapers of the time, such as Son Posta, and Ulus. These articles covered child mortality and the importance of raising healthy children. However, in Alantar's view, more than these efforts were needed. He argued that state institutions must pay close attention to this matter. During pregnancy, he stressed the need for mothers to receive regular monitoring from nurses and midwives and in maternity and nursing homes. Alantar underscored the vital importance of assisting the child during and immediately after birth. Moreover, he advocated for promoting breastfeeding among mothers. Families, he believed, should be educated on promptly treating sick children, protecting against infections, and adhering to cleanliness guidelines. He emphasized that disseminating all this information fell under the purview of government institutions. Alantar emphasized the importance of informing midwives, mothers, girls destined to become mothers, female students, teacher candidates, and nannies. He also advocated for incorporating child-rearing guidelines into the curricula of girls' high schools and organizing conferences for women (Alantar, 1949b, pp. 126-288). In other words, his child policy was centred around the role of the mother. He passionately advocated for state intervention in women's lives and bodies to ensure the well-being of children.

According to Alantar, entrenched societal habits could not undergo an abrupt change; it was the responsibility of the new generation to bring about such transformation. Therefore, raising children in a manner befitting the modern era and the homeland's aspirations was imperative. In achieving this, mothers played as significant a role as the state and its institutions. This perspective meant that motherhood was perceived as a noble public service aimed at a grander goal. Nonetheless, as previously mentioned, there existed concerns that the general populace, and mothers in particular, might not be adequately equipped to nurture the children, the nation's "capital," as Alantar described it. This duty could not be entrusted to mothers who lacked modern knowledge. They needed to be educated in the latest scientific principles, a responsibility that only medical doctors could fulfil. As a result, medical doctors assumed the

pedagogical role of the state, providing mothers and the entire nation with education in modern social hygiene (Tunç, 2019, p. 44).

Figure 1.

A nursery plan (Alantar, 1949b, p. 239)
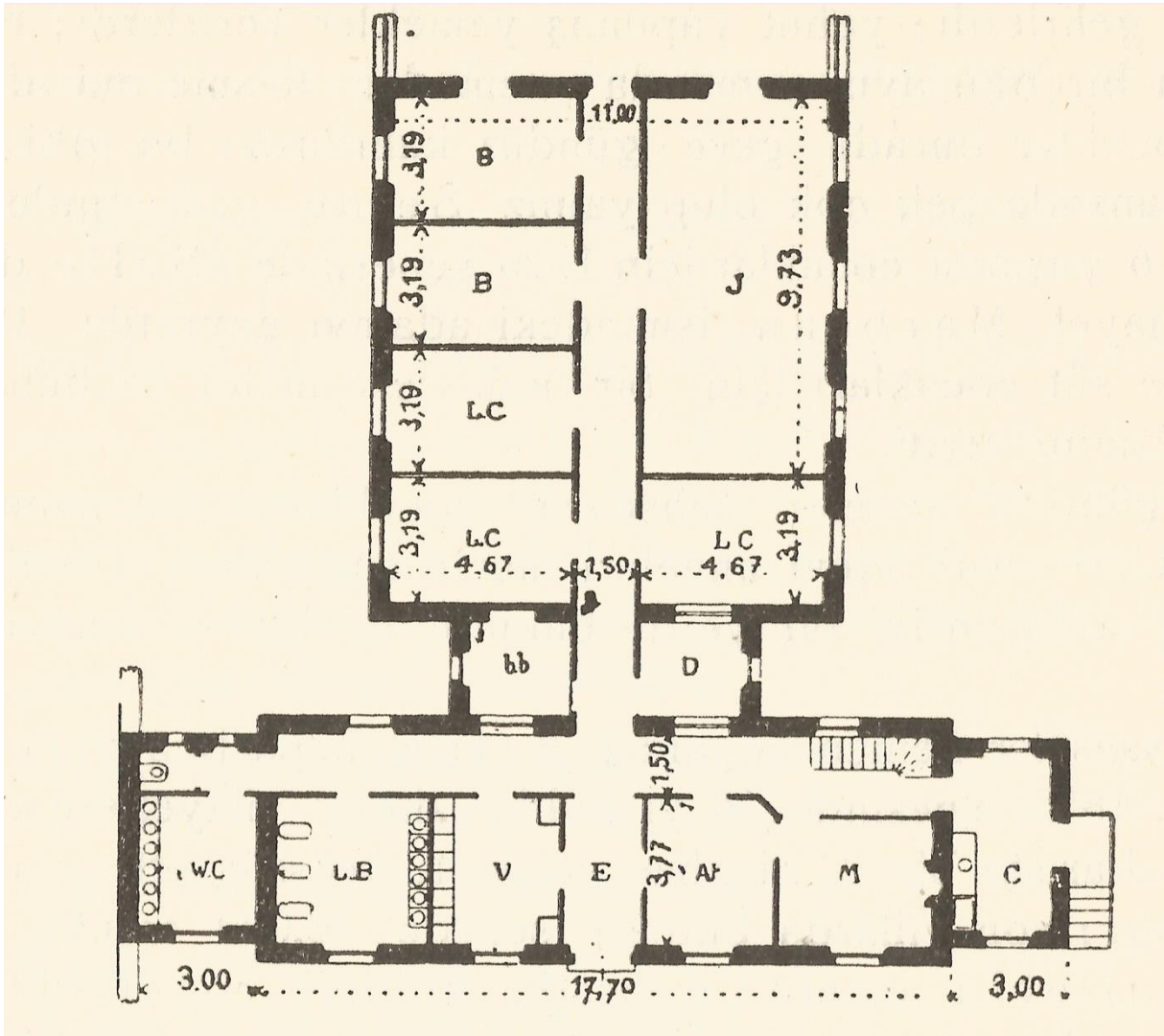
In addition to women's education, the state's establishment of childcare homes, breastfeeding rooms, and nurseries during this critical postpartum period, marked by high child mortality rates, was of utmost importance. In his work, Alantar meticulously outlined the ideal structure of such institutions, drawing inspiration from European models. He provided detailed sketches (Figure 1 and 2) and enthusiastically reported their initial implementation, predicting their expansion in the future, which he believed would contribute significantly to the nation's progress and development (Alantar, 1949b, pp. 229-265).

Figure 2.

A school plan for secondary education (Alantar, 1949b, p. 270)
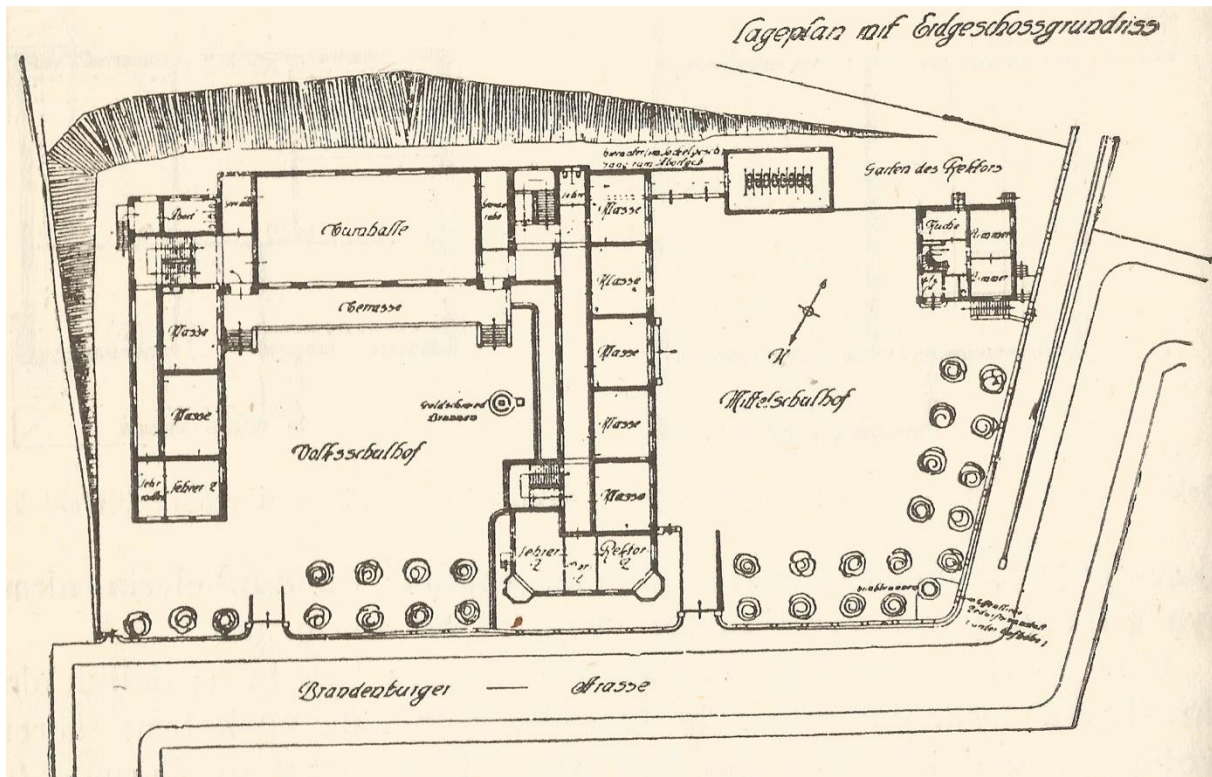
One of the critical areas of emphasis for Alantar in social hygiene was school health. In his publication titled "Healthy School Youth", (1944b) released by the Ministry of Education, he intricately connected the significance of this issue with population policy. The primary objective was to ensure that the younger generation, upon whom the nation's future rested, was free from disease and possessed robust health. Alantar firmly believed that youth raised without sound health would not contribute effectively to the nation's advancement. He emphasized the importance of school health by linking it to the concept of citizenship, explaining that when he referred to health, he meant physical strength and the vitality of the spirit. According to him, this was possible by arranging every detail, from the building structure of the schools to the curriculum, with modern scientific methods (Alantar, 1949b, pp. 266-300). His conception of schools was a blend of pseudo-scientific, political, moral, and authoritarian elements, like his approach to mothers. He meticulously illustrated a portrait of the "ideal student", encompassing everything from how children sat at their desks to how they conducted themselves when standing. According to him, this disciplined model would have created citizens who would have raised the Türkiye of the future.

Discussion & Conclusion

Alantar was part of a group of elites who saw themselves as servants of the nascent Republic of Türkiye, striving to transform it into a powerful and contemporary nation. He held the conviction that Türkiye could establish a comprehensive system for child welfare by aligning its policies with those of advanced European nations and

America. Alantar approached the issue of child welfare by considering both individual and social, advocating for active state involvement in both realms. He staunchly opposed conventional child-rearing practices and fervently advocated for their eradication, advocating instead for implementing systematic state oversight in child welfare. In his view, this shift was imperative for the advancement of civilization. Much like many elite doctors of the Republican era, he equated population policy with motherhood, regarding mothers as pivotal figures in shaping future citizens. He promoted state intervention in women's lives to safeguard their children's well-being. He believed that the general public, particularly mothers, should receive education in modern social hygiene, placing a strong emphasis on state control in this regard. It is worth noting that Alantar's vision of control had no bounds; in his perspective, the state should exercise a highly authoritarian role, especially concerning public health, particularly child health. This authoritarian stance was also evident in his approach to school health.

Eugenics played a pivotal role in shaping Alantar's medical beliefs, much like it did for numerous physicians of his era. He believed their racial background significantly influenced a child's physical and spiritual development. He expanded the eugenic definition with a multifaceted approach considering heredity, environment, and postnatal care. According to him, eugenics would continue after the child was born, and the way to prevent this was to ensure child welfare. This belief was another reason for his support of state control over child health, and welfare.

Alantar was a classical republican elite. As a prominent figure in his field, he not only held influential views but also played a pivotal role in disseminating state-centred ideologies that closely aligned with his own, and he left an enduring impact on the discourse of his time.

Ethic

This study does not require ethics committee approval since it did not include human participants.

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