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An Investigation into Open-Ended Question Preparation Skills of Turkish Language Teachers

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ABSTRACT

The aim of this study is to determine the level of Turkish teachers' preparation of open-ended questions, to determine the intensity of using open-ended questions, and to offer solutions for the problems that teachers encounter in these issues. A case study method was used in the study, where a qualitative research method was preferred. First, a semi-structured interview technique was used with teachers who preferred open-ended questions in their exams. The data collected through the interview was examined using the descriptive analysis method. The interview was conducted with 13 Turkish teachers working in Tortum district of Erzurum. In the second part of the study, a document review was conducted. With the permission of the Erzurum Provincial Directorate of National Education, the open-ended exam questions used by Turkish teachers in 7 secondary schools in Tortum district in the 2018-2019 and 2019-2020 academic years were examined. According to the research findings, teachers complain about the answering times of open-ended questions, low content validity, and problems experienced in evaluation. Written questions consist of simple level questions such as reading comprehension. According to the results of the research, teachers are aware of the importance of the open-ended question type in teaching Turkish. However, their skills in preparing these types of questions are at a low level. When evaluating open-ended questions, it was determined that the prepared answer keys were not very detailed, so their reliability was low. It was also concluded that simple level reading comprehension questions negatively affected validity.

Keywords: Turkish language teaching, assessment and evaluation, open-ended questions.

Introduction

In recent years, one of the vital topics in teaching programmes is measurement and evaluation. "Alternative Measurement and Assessment Methods", which has become more popular with these programs, has started to have an essential role in the Turkish education system. Mentioned method, which has recently been known as "New Approaches in Education and Training", has brought new concepts in the area of measurement and evaluation. In the curricula published by the Ministry of National Education; multiple-choice items, short-answer items, matching items, open-ended questions, true-false items, attitude scales, performance homework, student product file, and project homework are included in the curriculum as complementary measurement tools. With the changed curriculum; interview, observation form, self-assessment form, peer assessment form, speaking skill assessment form, listening / monitoring skill observation form, reading skill checklist, written expression assessment form, student work file assessment form, group work self-assessment form, product file assessment form, project and performance homework assessment form have also taken their places in the new curriculum as evaluation tools.

Measurement and assessment methods in the Turkish language teaching programme can be examined under three headings. These evaluations are those made at the beginning of the academic year, those made during the academic year and those made at the end of the academic year (Göçer, 2018). Determining the level of pupils at the beginning of the process is of great importance before starting teaching. At the very first stage of the teaching process, students' opinions about the course, their speaking, writing, listening, reading and grammar skills and attitudes can be determined. In order to determine the

specified level, measurement tools such as achievement tests, attitude scales, rubrics, and observation forms are used. The measurement made at the beginning of the year is very important in regard to how much the students improved themselves. The purpose of the evaluations made during the process is to evaluate teaching and identify mistakes in learning. Observation tests, performance and project homework, student product files, etc. are used here. Similarly, tools such as observation forms, checklists, peer assessment and self-assessment forms are used to determine to what extent and how the goals set during the academic year are achieved (Göçer, 2018).

These tools, which are frequently used by teachers and students in the area of measurement and assessment, have been a source of many studies. Many situations, such as how much these tools are adopted by students, how they are applied in our education system, and the opinions of practitioners, have been the subject of study for researchers. Bekaroğlu (2007), in the outcomes of his research, discovered that teachers did not prepare questions for a purpose, they focused on questions at the knowledge level more, they did not use analysis and synthesis type questions much and they did not benefit from texts in the question types. Güfta and Zorbaz (2008), in their study, found that questions were mostly asked at lower cognitive levels in the written exams of Turkish courses. In their study, Akyol et al. (2013) found that they generally used simple comprehension-level questions while preparing questions and prepared questions related to texts that mostly required lower-level cognitive skills. Kavruk and Çeçen (2013), who investigated what level of skills are measured in the exam questions which are prepared by Turkish language teachers, found that a significant majority of the questions were in the knowledge, comprehension and application section, which consists of lower-level skills. Based on the results of Yiğit's (2013) research, it was observed that teachers accepted the functions of alternative assessment-evaluation methods described in the Primary School Turkish Language Teaching Programme. On the other hand, it was found that teachers had suspicions about the efficiency of the peer assessment method. In their study, Maden and Durukan (2013) aimed to determine the distribution of the questions used in the written exams of the Turkish language course regarding skill areas, objectives and achievements, question types and their equivalents in the taxonomy of cognitive steps. As a result of their study, they concluded that short-answer and multiple-choice question types were generally emphasised in the exams, the questions were mostly concentrated on the lower level cognitive skills of remembering and understanding, and the questions generally measured certain objectives and achievements in reading and writing skill areas. Considering the results of Birgili's (2014) study, in which he aimed to investigate the separation of multiple-choice and open-ended questions in terms of high-level cognitive and affective areas, it is seen that open-ended questions have an important role in revealing the self-control skills and cognitive strategies of 8th-grade students.

According to another result, students spend the most energy while solving open-ended questions. Additionally, it was detected that multiple-choice questions worried students more than open-ended questions. Yıldız (2015) stated in his study that the questions were mostly at the conceptual knowledge level in terms of knowledge and at the comprehension level in terms of cognitive process. Temizkan and Sallabaş (2015) found that students were more successful in multiple-choice questions compared to open-ended questions when solving reading comprehension questions. Yavuz and İlgeç (2016) found discrepancies between the scores given by teachers on the same answer sheet. As a result of his research, Acar (2018) stated that test and question item statistics should be interpreted as well as the quality of the scoring method used in written exams. İnceçam et al. (2018) noted in their study that although open-ended questions are frequently used in written exams, teachers are not qualified to prepare these question types. Aydın (2019) found in his study that multiple choise exams are mostly preferred in Turkish lessons, followed by mixed format and written exams, respectively; in addition, 8% of all exam questions do not meet any acquisition and the distribution of questions for the skill areas in the programme is not at the same rate in the exam questions. Tatlı (2019) found in his study that the types of open-ended questions varied according to school types and that the questions also differed from school to school in terms of achievements. Rawadieh (1998) analysed 822 questions in his study by using Bloom's Taxonomy. Based on the results of the research, he determined that the questions were 35% at the knowledge stage, 48% at the comprehension stage, 1% at the application stage, 9% at the analysis stage, 4% at the synthesis stage and 3% at the evaluation stage. According to this, 84% of the questions are in the lower level cognitive skills level. Risner, Nicholson and Webb (2000) classified 100 questions in social studies textbooks using Bloom's taxonomy. Similar to the results of other studies, it was determined that 69.5% of the questions measured lower-level cognitive skills and 30.5% measured higher-level cognitive skills. Khan and Inamullah (2011) analysed 267 questions of primary school teachers by using Bloom's

Taxonomy. As a result of their research, they detected that the questions were 67% at the knowledge stage, 23% at the comprehension stage, 7% at the application stage, 2% at the analysis stage and 1% at the synthesis stage. No questions were identified in the evaluation stage, and it was stated that most of the questions were in the lower level cognitive skill stages. In many places in the Turkish Language Teaching Programmes (MoNE, 2005, 2017), it is explained that students should develop many high-level skills and mental skills such as understanding, questioning, sorting, classifying, establishing relationships, predicting, analysing, synthesising, evaluating, problem solving, making meaning between texts, questioning, criticising, interpreting, constructing in mind. In order to accomplish all these things, teachers need to know how to develop students' thinking skills in different ways and creatively. Questions are one of the most important measurement tools to be used in this direction. In this case, the competencies of teachers in the questions to be formed in order to measure these skills are an issue that needs to be examined (Akyol et al., 2013). It has become a necessity to investigate that these types of question items are more successful in measuring what kind of skills, the difficulties encountered while preparing them, the teachers' and students' opinions, and the positive or negative situations experienced in practice. In the study, it was aimed to specify what the teachers pay attention to when preparing open-ended questions, whether the questions are prepared in line with the learning outcomes, how the scoring and evaluation are carried out, and at what level they are in terms of validity and reliability. In this regard, answers to the following questions were sought:

1. How are Turkish teachers' habits of preparing open-ended questions?
2. What are the levels of open-ended questions in the exams which are prepared by Turkish teachers according to the renewed Bloom classification?
3. What is the level of perception and answering of open-ended questions by students?
4. In which type of skills are open-ended questions used more frequently?
5. What kind of problems are faced in terms of evaluation in the exams prepared by using open-ended questions?
6. What precautions should be taken to minimise the subjectivity of scoring and errors that may be made by the scorer?
7. What are the teachers' opinions on assessment and evaluation with open-ended questions?

Methods

Research Model

This study, in which Turkish language teachers' open-ended question preparation skills will be examined, is a case study among the qualitative research methods. Case study is a qualitative research method in which a situation limited in time is examined in detail by using data collection tools like interviews, observations and documents, and the issues related to the situation are described (Creswell, 2007). Davey (1991) defines a case study as a method in which a situation or case is examined in detail, data is gathered systematically and how it is reflected in the real environment is examined.

In this report, which is considered as a qualitative case study, open-ended written questions were analysed in order to identify an existing situation or problem and to develop solutions for this situation, and teachers' opinions about open-ended questions were determined.

Participants

A semi-structured interview was conducted with the teachers preparing the open-ended written questions to be used in this study. The participants of the interview consisted of 13 Turkish language teachers working in 7 secondary schools in Tortum district of Erzurum province. Maximum variation sampling, which is one of purposeful sampling methods, has been used to identify the teachers. The selection of teachers working in schools in all conditions enabled the collection of more reliable data for the research. Accordingly, central secondary schools, imam hatip secondary schools, regional boarding secondary schools, neighbourhood/village secondary schools and secondary schools from rural areas are the schools in the study. At the same time, both new and head teachers are included in the study in order to ensure a balanced distribution of teachers' tenure.

Data Collection

With the permission of Erzurum Provincial Directorate of National Education, an equal number of written exam papers consisting of open-ended questions used at the 5th, 6th, 7th and 8th-grade levels in the 2018-2019 and 2019-2020 academic years were taken from Turkish language teachers working in 7 secondary schools in Tortum district. The semi-structured interview form presented in the appendix has been used to collect other data through interviews. This technique, which is one of the interview types, provides the opportunity to receive in-depth information on the subject being researched. In addition, while applying this technique, the researcher both uses the questions prepared in advance and has the chance to ask

new questions according to the process of the interview (Yıldırım & Şimşek, 20).

In the process of preparing and developing the interview questions to be used in the research, significant importance was attached to the questions being easy to understand and not directing the participant. Expert opinions were consulted to determine whether the questions to be used were prepared in line with the problems of the research and whether they were understandable and applicable. The form was prepared by taking expert opinions.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Atatürk University Social and Humanitarian Ethics Committee Ethics Committee (Date: 06.05.2020, Sayı: E-2000118598)
- Informed consent has been obtained from the participants.

Data Analysis

The open-ended written exam samples to be used in this study were analysed using the document analysis method. With this method, the data that the researcher wants to obtain can be obtained without the need for any observation or negotiation. Document analysis saves time and money. Also when applied together with data collection methods such as interview, observation, etc., it will increase the validity of the research as it will provide data diversification (Yıldırım & Şimşek, 2016).

The levels of open-ended questions in written exams were evaluated in a general way in line with the restructured Bloom classification. Firstly, a literature review was conducted to analyse the open-ended questions of written exam regarding the stages in the taxonomy. Then, descriptive analysis was made by using percentages and frequencies related to the distribution of open-ended questions to the stages.

As a result of the research, to ensure the dependability of the analysis of the open-ended written exam questions collected, the opinions of 3 field experts and 2 doctoral students with doctoral qualifications were consulted. When the opinions of the evaluators were analysed, the classification in which 4 of 5 experts had the same opinion was taken as a basis.

The descriptive analysis technique was used to analyse the interview data collected during the research process. In descriptive analyses, the collected data are summarised according to predetermined themes and interpreted by the researcher. In this type of analysis, the thoughts of the interviewees can be conveyed directly and the narratives can be presented in a striking way. The aim of this type of analysis is to transfer the data in an organised and interpreted way (Yıldırım & Şimşek, 2016) data collected as a result of the interview and consistency was obtained as a result of the comparison of these evaluations. In order to ensure the external reliability of the research, detailed information about the participants, details about the research process, theoretical information about the analysis of the collected data and details about the methods were conveyed in detail. In addition, the findings were reported and saved in order to make comparisons and to be used in other studies.

Results

Findings Regarding Written Questions

Table 1 indicates the distribution of open-ended questions prepared by Turkish language teachers on cognitive levels to the revised Bloom's taxonomy. 599 open-ended questions in 133 mixed-format exams and 7 written exams prepared by 15 different teachers were analysed by using the document analysis method and the distribution of these questions to cognitive stages was shown at grade levels.

While the distribution of the questions to the grade levels shows similar characteristics, clustering is observed at the remembering and understanding levels.

Table 1.
Distribution of the Grades 5, 6, 7 and 8 Turkish Language Open-Ended Written Exam Questions by the Cognitive Stages in the Restructured Bloom's Taxonomy and Grade Levels

Cognitive steps	5th Grade		6th grade		7th grade		8th grade		Total	
	f	%	f	%	f	%	f	%	f	%
Remembering	53	34	56	33	47	39	54	35	210	35
Understanding	65	42	66	39	54	44	66	42	251	42
Applying	13	9	14	8	6	5	13	8	46	8
Analyzing	6	4	8	5	5	4	8	5	27	4
Evaluating	2	1	3	2	2	2	3	2	10	2
Creating	15	10	21	13	7	6	12	8	55	9
Total	154	100	168	100	121	100	156	100	599	100

Out of 599 open-ended questions in the written exam papers analysed within the scope of the research, 406 (68%) were used in the achievement of reading comprehension skills. It is observed that reading comprehension questions are quite inadequate in terms of high-level cognitive skills.

Table 2.
Results Based on the Distribution of Reading Comprehension Questions Prepared in the Form of Open-Ended Questions to Cognitive Stages.

Cognitive Step	f	%
Remembering	210	52
Understanding	169	42
Applying	0	0
Analyzing	27	6
Evaluating	0	0
Creating	0	0
Total	406	100

The second important role in the distribution of open-ended questions belongs to writing skills. Table 3 shows the results of the distribution of the questions related to writing skills prepared as open-ended questions to cognitive stages (Table 2).

Of the total open-ended questions, 23% were prepared to measure writing skills. In the distribution of writing skills in terms of cognitive stages, the results were found only in the understanding and creating stages. It was identified that open-ended type questions involving writing skills were not used in the other stages. It is understood that the questions in the understanding stage (60%, Table 3) consist of writing an essay based on the proverb or aphorism given, and the questions in the creating stage consist of completing the texts such as fables, fairy tales, stories, etc. in a unique way or writing original essays, stories, tales.

Table 3.
Results Based on the Distribution of Writing Skill Questions (Composition) Prepared in the Form of Open-ended Questions According to Cognitive Stages

Cognitive Step	f	%
Remembering	0	0
Understanding	82	60
Applying	0	0
Analyzing	0	0
Evaluating	0	0
Creating	55	40
Total	137	100

Figure 1 presents the comparison of open-ended type questions in the mixed format and written exams used in Turkish exams with the other questions set in the same exams.

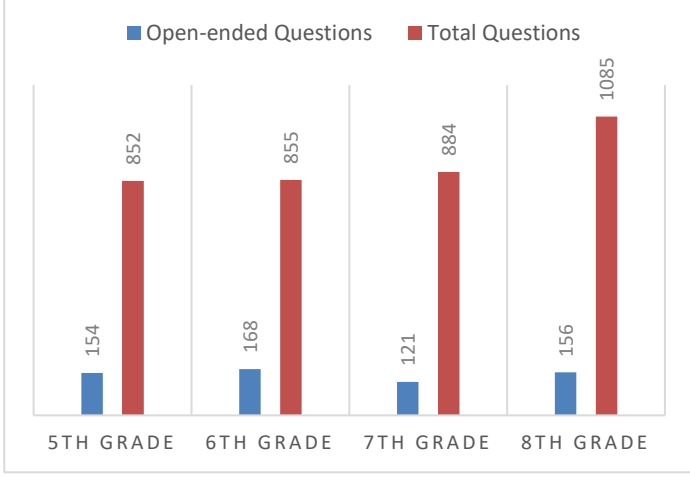

Figure 1.
The Ratio of Open-Ended Questions Asked in Turkish Language Exams to Other Questions.

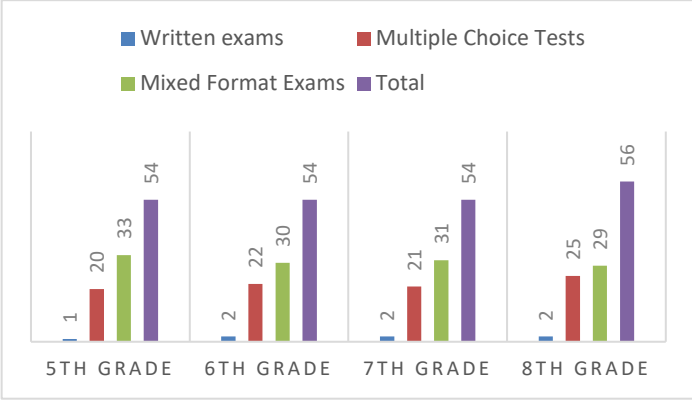

Figure 2.
Distribution of All Types of Exams Conducted by Teachers According to Grades

The types of exams used by Turkish language teachers and the use of these exams according to the grade levels are shown in Figure 2.

The types of questions used in the mixed and written exams prepared by Turkish teachers and their distribution to grade levels are shown in Table 4. In the exams where a total of 3,686 questions were used, it was seen that the most asked questions were multiple choice questions. Accordingly, it was determined that 2,680 (73%) questions were multiple choice questions, 599 (16%) were open-ended questions, 110 (3%) were short-answer questions, 28 (0.8%) were matching questions and 6 (0.16%) were true-false questions.

Table 4.
Results Related to Question Types in Mixed Format and Written Exams Prepared by Teachers

Grade Level	Question Types					Total
	Open Ended	Multiple Choice	Short Answer	Matching	True False	
5	154	615	69	20	4	862
6	168	609	58	17	3	855
7	121	671	68	20	4	884
8	156	785	110	28	6	1085
Total	599	2680	305	85	17	3686

Findings Regarding Sub-Problems

What are the Habits of Turkish Teachers in Preparing Open-Ended Questions?

When the teachers who participated in the interview were asked what they consider when preparing open-ended questions, 54% of the teachers stated that they prepare questions in a way that can take measurement the high-level cognitive skills in the taxonomy, 38% stated that they try to prepare questions that will be clearly understood by all their students, 31% stated that they pay attention to ensure that the question to be prepared is appropriate to the level of the student, 15% of them stated that they chose questions appropriate to the students' level of readiness, 15% stated that they prepared questions appropriate to the curriculum and lesson plan, 15% stated that they preferred questions that would not cause problems in scoring while evaluating, and 7% stated that they preferred questions with clear limits as opposed to questions with very long answers (Table 5).

Table 5.
Results Related to the Question "What do you pay special attention to when formulating open-ended questions?"

What do you pay special attention to when formulating open-ended questions?	f	%
I ask questions that can measure higher-level cognitive skills in the taxonomy.	7	54
I ask clear and understandable questions.	5	38
I make sure that the question is appropriate to the student's level.	4	31
I prepare questions according to the student's readiness level.	2	15
When preparing questions, I do so in accordance with the curriculum and lesson plan.	2	15
I prepare questions that I will not have difficulty in scoring.	2	15
I prepare questions that will have limited answers.	1	7

At Table 6 when the teachers who took part in the interview were inquired why they preferred open-ended questions in their exams, 54% of the teachers said that they preferred these question types to measure higher level skills, 23% said that they preferred these questions because students expressed themselves better in these questions, 15% stated that they prefer these questions because they think that they provide the opportunity to practice instead

of memorisation in learning, 7% stated that they are useful in measuring the achievements, 7% stated that they prefer these questions because they eliminate the chance factor in the exam, and 7% stated that they prefer these questions when they want to measure students' writing skills.

Table 6.

What is your reason for preferring open-ended questions in your exams?

What is your reason for preferring open-ended questions in your exams?	f	%
I prefer it because it measures high-level skills.	7	54
I prefer it because it allows students to express themselves.	3	23
I prefer it because it allows practice instead of memorization.	2	15
I prefer it because it is useful in measuring gains.	1	7
I prefer it because it eliminates the luck factor.	1	7
I use it to measure writing skills.	1	7

What are the Levels of Open-Ended Questions in Exams Prepared by Turkish Teachers According to Bloom (1956) Classification?

A total of 599 open-ended questions were identified in 133 mixed format and 7 written exams prepared by Turkish language teachers to be used at all grade levels and their distribution to cognitive stages was analysed. According to this, the highest number of 210 (35%) questions are found in the remembering stage. This is followed by the understanding (comprehension) stage in which 251 (42%) questions are used. There are 55 (9%) questions in the creating stage, 46 (8%) in the applying stage, 27 (4%) in the analyzing stage and 10 (2%) in the evaluating stage. While it is observed that the questions are used intensively in the remembering, understanding and creating stages, it is seen that there are fewer questions in the applying, analyzing and evaluating stages (Table 7).

Table 7.

Distribution of the grades 5, 6, 7 and 8 turkish language open-ended written exam questions according to cognitive stages

Grade	Remb.	Und.	App.	Anl	Eva	Cre	Total
5	53	65	13	6	2	15	154
6	56	66	14	8	3	21	168
7	47	54	6	5	2	7	121
8	54	66	13	8	3	12	156
Total	210	251	46	27	10	55	599

In Table 8 when the Turkish teachers who participated in the interview were asked which types of skills open-ended questions were used more frequently to measure, 38% of the teachers answered analysis, 38% stated that they measured creativity skills, 31% stated that they measured synthesis skills, 23% stated that they measured problem solving, application, writing and punctuation skills, 15% stated that they measured comprehension, evaluation, visual reading, expression ability, text creation and commenting skills, while 7% stated that they measured the skills of using information, critical thinking, decision making, self-realization, giving examples and learning by doing-experiencing.

Table 8.

Results for the Question "Which types of skills do open-ended questions provide more advantages in measuring in your exams?"

Which types of skills are open-ended questions used more frequently in measuring?	f	%
Analysing	5	38
Creativing	5	38
Synthesing	4	31
Problem Solving	3	23
Application	3	23
Spelling and Punctuation	3	23
Understanding	2	15
Evaluation	2	15
Visual Reading	2	15
Expression Ability	2	15
Text Creation	2	15
Comment	2	15
Using Information	1	7
Critical Thinking	1	7
Decision Making	1	7
Self-Actualization	1	7
Giving Examples	1	7
Learning by doing and experiencing	1	7

What is the level of perception and answering of open-ended questions by students?

The results in Table 9 related to the true and false answer rates of the open-ended type questions by the students were analysed, and the Turkish language teachers whose exam questions were examined used a total of 3686 exam questions at all grade levels in the classes they taught. 599 (16%) of these questions consisted of open-ended questions. It was seen that 599 open-ended questions used in Turkish language exams were answered correctly 7,945 (85%) times in total and 1,399 (15%) times incorrectly. The fact that 85% of the open-ended type questions were answered correctly means that the questions were perceived and answered correctly by the students at a high rate.

Table 9.

Results for the Distribution of the Rates of Answering Open-Ended Questions by Students According to Grade Levels.

Grade	Total Questions	Open Ended Q.	True Answer		False Answer	
			f	%	f	%
5	862	154	2.082	86	331	14
6	855	168	2.081	87	310	13
7	884	121	1.764	83	367	17
8	1.085	156	2.018	84	391	16
Total	3.686	599	7.945	85	1.399	15

In which types of skills are open-ended questions used more frequently?

In Table 10 the results regarding the distribution of open-ended questions used in Turkish language exams according to the skill areas (acquisition) and grade levels in the Turkish language teaching programme were examined.

Table 10.
Results for the Distribution of Open-ended Written Exam Questions According to the Skill Areas in the Turkish Language Teaching Programme.

Grade	Open End Question	Listening/Watching		Speech		Reading		Writing	
		f	%	f	%	f	%	f	%
5	154	0	0	0	0	103	67	51	33
6	168	0	0	0	0	119	71	49	29
7	121	0	0	0	0	81	67	40	33
8	156	0	0	0	0	103	66	53	34
Total	599	0	0	0	0	406	68	193	32

Accordingly, 406 (68%) of 599 open-ended questions were used to measure reading skills, while 193 (34%) were used to measure writing skills. No open-ended questions were used for listening/watching and speaking skills (Table 10).

What kind of problems can be encountered in terms of evaluation in exams prepared using open-ended questions?

When the teachers who participated in the interview were asked what kind of problems they experienced during the scoring of open-ended questions, 38% of the teachers stated that they experienced problems due to each student giving unique answers, 31% stated that the scoring affected the scoring of other answer sheets, 23% stated that grammatical errors affected the scoring, 15% stated that they had problems in scoring due to spelling and punctuation errors, and another 15% stated that they experienced scoring problems due to insufficient time (Table 11).

Table 11.
Results for the question "What kind of problems do you experience in the scoring of such questions?"

What kind of problems do you experience with scoring these types of questions?	f	%
Authentic answers	5	38
Scoring affects other answer sheets	4	31
Grammar mistakes	3	23
Spelling and punctuation mistakes	2	15
Lack of time	2	15

What precautions should be taken to minimise the subjectivity of scoring and errors that may be made by the scorer?

When the Table 12 on the scoring of open-ended questions prepared by Turkish language teachers is examined, it is seen that only scoring key and overall impression scoring methods are used among the scoring methods used in Turkish language written exams, and ranking and categorising scoring methods are not used. It was determined that the scoring key method was used in 111 (79%) and the scoring by overall impression method was used in 29 (21%) of a total of 140 exams, including mixed format (133) and written (7) exams with open-ended questions.

Table 12.
Results for the scoring of the open-ended questions analysed

Grades	Number of exams	Scoring Key		Categorising		Ranking		Scoring by Overall Impression	
		f	%	f	%	f	%	f	%
5	37	31	84	0	0	0	0	6	16
6	35	29	83	0	0	0	0	6	17
7	34	26	76	0	0	0	0	8	24
8	34	25	74	0	0	0	0	9	26
Total	140	111	79	0	0	0	0	29	21

What are the opinions of teachers on assessment and evaluation with open-ended questions?

When the teachers who participated in the interview were inquired about the difficulties of preparing open-ended questions, 54% of the teachers stated that it was more difficult to prepare open-ended questions than other question types, 38% stated that open-ended questions were low in covering the achievements, 23% stated that it was more difficult to score open-ended questions than other question types, and 1% informed that students did have more difficulties in answering the type of open-ended questions than other question types (Table 13).

Table 13.

Results concerning the question "What are the difficulties of preparing open-ended questions?"

What are the Difficulties of Preparing Open-Ended Questions?	f	%
It is more difficult to prepare than other question types	7	54
It has low content validity	5	38
It is more difficult to score than others	3	23
Students have difficulties in answering this type of questions	1	7

When the teachers who participated in the interview were asked about their opinions on the content validity of the open-ended questions, 54% stated that the content validity of the open-ended questions was low, 38% stated that the content validity was partially low, and 1% stated that they had no content validity problem (Table 14).

Table 14.

Results concerning the question "What are your opinions about the content validity of a Turkish language written exam consisting of open-ended questions?"

What are your thoughts on the content validity of a Turkish written test consisting of open-ended questions?	f	%
Content validity is low.	7	54
Content validity is relatively low.	5	38
I don't have any content validity issues.	1	7

When the teachers who took part in the interview were inquired about their thoughts on the reliability of open-ended questions, 38% of the teachers stated that reliability may vary from scorer to scorer, 23% stated that they found open-ended questions reliable, 15% stated that they did not find open-ended questions reliable, 15% stated that the reliability of open-ended questions may vary depending on the number of questions, and 15% stated that reliability may vary from teacher to teacher (Table 15).

Table 15.

Results for the Question "What are your opinions about the reliability of open-ended questions?"

What are your opinions on the reliability of open-ended type questions?	f	%
Reliability depends on the scorer.	5	38
I find it reliable.	3	23
It is not reliable.	2	15
It depends on the number of questions.	2	15
It depends on the teacher.	2	15

Discussion

It is seen that open-ended questions were adequately included in the written and mixed format exams prepared by the teachers. In mixed format format exams, it was determined that most of the required question types were used. However, the high number of multiple-choice questions and the exams in the format of tests involving entirely multiple-choice questions were remarkable. Ünlü et al. (2014), Yıldız (2015), Şanlı and Pınar (2017), Aydın (2019) and Akar (2019) received similar results in their works. In the interviews, it was determined that teachers' awareness of the type of open-ended questions was high. However, the questions in the exams examined

concentrate on certain cognitive steps and achievements. It was determined that the questions were capable of measuring lower-level cognitive skills and the achievements of reading skills at a high rate. In addition, while writing skills were included in a limited number of questions, speaking and listening/monitoring skills were not included at all. It was seen that the pupils did not have any difficulty in perceiving and answering the questions. These types of questions are used to determine students' skills such as thinking, questioning, understanding and writing, and to determine their interests and attitudes (Güneş, 2012). Open-ended questions are used to try to elicit students' learning about a particular topic in as a natural and extensive way as possible. Thus, closed alternatives that prevent a detailed and complete explanation are avoided (Friborg & Rosenvinge, 2011). In addition to being used in the measurement of high-level skills, their easy preparation is also an outstanding factor in their election.

They are used to measure behaviours at higher levels in the cognitive domain, generally at the level of synthesis and evaluation (O'Neil & Brown, 1998).

In the analysis, it is seen that the rate of answering correctly was quite high. It is thought that the correct answer rate was high due to the fact that the questions were used in the measurement of both simple reading comprehension and low-level cognitive skills.

In the teacher interviews, it is understood that another issue complained about open-ended questions is the validity and reliability of such questions. Especially the view that these questions are inadequate in terms of content validity is predominant. Lack of time and problems in limiting the answers bring along the necessity of preparing a limited number of questions. Although exams consisting entirely of open-ended questions are rarely preferred, it is understood that the same problems are experienced in mixed-format exams with open-ended questions.

It is certain that the limited number of open-ended type questions and the problems experienced in the evaluation process have a direct effect on reliability. It is realised that the teachers' failure to use a detailed key, the undesirable expressions in the students' answers, and the mistakes related to writing and grammar reduce the objectivity of the scoring and the reliability of the exam.

When the distribution of the questions according to the achievements in the curriculum was viewed, it was understood that open-ended questions were only used to measure certain achievements. From this inference, it can be concluded that teachers did not take the achievements into consideration while preparing open-ended questions. It is understood that multiple-choice and other question types were used more than open-ended ones in the measurement of the achievements belonging to other skill areas.

It was found that one of the reasons why open-ended questions were less preferred was the negative aspects they had in terms of evaluation compared to other question items. It was detected that the experienced difficulties were that the evaluation took a longer time, the students deviated from the expected answer, and the time could not be adjusted as desired. As a scoring method, it was observed that the most used scoring method was scoring key and the second most used scoring method was overall impression scoring. While a detailed key was prepared for other question types in the scoring key, it was understood that a detailed key was not prepared for open-ended questions or they were scored with an overall impression. This situation revealed score differences between students and between classes. It was detected that the fact that teachers did not prepare a detailed key in the scoring of open-ended type questions caused them to be quite generous in evaluating these questions.

When it comes to the outcomes of the research, it is concluded that teachers have sufficient subject matter knowledge about the functions and application areas of open-ended questions. In the interviews, it was determined that there were enough open-ended questions in all of the mixed format exams despite the problems experienced in content validity and evaluation. However, it was concluded that open-ended question preparation skills were at a low level. When the open-ended questions were analysed, it was determined that these types of questions were principally set as simple reading comprehension questions and they were located in the lower level cognitive skills concerning cognitive levels. Since a detailed key was not developed for scoring, it was understood that their reliability was quite low. Preparing questions that measure only certain achievements also creates a negative situation in terms of validity.

Conclusion and Recommendations

It would be very productive for teachers to participate in training activities related to open-ended questions. It is known that the number of distance or face-to-face courses on open-ended questions has increased recently. Especially attending open-ended question preparation courses given in measurement and evaluation centres will be beneficial. In addition, while formulating open-ended type questions, it should be paid special attention to distribute the achievements equally. Measuring only reading comprehension skills decreases the reliability of the exam. At the same time, they should focus on questions that can measure high-level skills in terms of cognitive levels. The preparation of more detailed scoring keys will be useful in terms of objectivity. The fact that there is a point value for each part of the question will provide an advantage to both the answerer and the scorer. At the same time, it may be useful to apply to different scorers in order to minimise the problems in terms of scoring. Students should be given preliminary information about how to answer open-ended questions. In addition, allowing enough time will relieve the answerer.

School administrators should provide general information about the exams, guide teachers in the desired direction and support them for educational activities.

Especially at the beginning of the semester, it is necessary to determine and follow up on the qualifications of the exams to be held during the semester. In addition, school administrations should not restrict teachers in these and similar activities.

District and provincial directorates of national education can organise in-service training activities or seminars on topics such as question preparation techniques or alternative assessment and evaluation methods in cooperation with universities and non-governmental organisations. Under the coordination of national education directorates, experts in their fields can organise seminars in crowded schools or town centres.

It would be useful for a team consisting of universities, research organisations, assessment and evaluation experts and teachers under the coordination of the Ministry of National Education to conduct a comprehensive study on written exam questions across the country. As a result of the research, a guideline on how to conduct exams for all courses that are assessed in the form of exams, including the distribution of achievements, sample scoring keys, etc. can be prepared and made available to all teachers.

It has been determined that there are not enough studies on exam questions in the literature. It is understood that the existing studies generally consist of statistical results. Researchers may be advised to conduct more research on the quality of the questions and the validity and reliability of the exams. will be quite productive for teachers to participate in training activities on open-ended questions. It is known that the number of distance or face-to-face courses on open-ended questions has increased recently. It will be beneficial for them to participate in open-ended question preparation courses given in measurement and assessment centers. In addition, care should be taken to distribute the gains equally when preparing open-ended questions. Measuring only reading comprehension skills reduces the reliability of the exam. At the same time, they should focus on questions that can measure high-level skills in terms of cognitive steps. More detailed preparation of scoring keys will be useful in terms of objectivity. Including the score value for each section of the question will provide an advantage to both the respondent and the rater. At the same time, it may be beneficial to apply to different raters in order to reduce the problems that will be experienced in terms of scoring. Students should be given preliminary information on how to answer open-ended questions. In addition, giving enough time will relax the respondent.

School administrations need to provide general information about exams, guide teachers in the desired direction and support them in educational activities. Especially at the beginning of the term, the qualifications of the exams to be held during the term should be determined and followed up in the group teacher meetings. In addition, school administrations should not restrict teachers in these and similar activities.

District and provincial directorates of national education can organize in-service training activities or seminars on topics such as question preparation techniques, alternative measurement and evaluation methods in cooperation with universities and non-governmental organizations. Experts in the field can hold seminars in crowded schools or district centers under the coordination of national education directorates.

It would be beneficial for teams consisting of universities, research organizations, measurement and evaluation experts and teachers to conduct a comprehensive study on written exam questions across the country under the coordination of the Ministry of National Education. As a result of the research, a guideline including how exams will be conducted for all courses evaluated in the form of

exams, distribution of achievements, sample scoring keys, etc. can be prepared and made available to all teachers.

It has been determined that there is not enough study on exam questions in the literature. It is understood that the existing studies generally consist of statistical results. It can be recommended that researchers conduct research especially on the quality of the questions and the validity and reliability of the exams.

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Specific Learning Disability from the Perspective of Preschool Teachers: Symptoms and What to Do

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ABSTRACT

Specific Learning Disability (SLD) is a type of special need that can be diagnosed in the primary school period. However, research shows that there are some symptoms in the preschool period as well. It is thought that it is important for preschool teachers to be aware of these symptoms and inform primary school teachers and parents. From this point of view, this study aimed to determine the views of preschool teachers on SLD. The research was designed using basic qualitative research from qualitative research methods. Snowball sampling, one of the purposeful sampling methods, was used to determine the study group. Demographic information form and semi-structured interview questions developed by the researchers were used as data collection tools. Content analysis was used to analyse the data. As a result of the study, it was determined that preschool teachers generally focused on reading, writing, speaking and listening skills; that they would mostly interview parents and communicate with the school guidance service regarding a child with suspected SLD; and that they thought that symptoms with SLD could occur in the preschool period. The findings are similar to the related literature.

Keywords: Perspective, preschool, specific learning disability, teacher

Introduction

Samuel Kirk first proposed Specific Learning Disability (SLD) in 1962. A conference held in 1963 focused on students who had significant difficulties in school despite having normal or above-normal intelligence levels. This term began to be accepted by parents and experts (Kirk, et al., 2014). Kirk stated that children with SLD are a heterogeneous group with only one thing in common. This common feature is that they have a neurological-based problem that affects their learning in various ways (Bender, 2012).

There is a distinct difference between the academic achievement and performance of children with SLD. This difference shows itself primarily in areas such as writing, reading comprehension, reading, and mathematics (Kılıç-Tülü & Ergül, 2016). Accordingly, SLD is divided into four in the literature. These are reading disorder (dyslexia), math disorder (dyscalculia), written expression disorder (dysgraphia), and learning disorders not otherwise specified (Özçivit-Asfuroğlu & Fidan, 2016; NCLD, 2014). In addition, it is stated that problems such as self-management, social interaction, and social perception can be seen together with learning difficulties (Yiğiter, 2005).

If we look at the historical development of learning disability, we can see that it is divided into six stages. The first stage, the clinical stage, coincides with the 1920s. In this period, children with learning disabilities began to be diagnosed differently from children with mental retardation. The studies carried out during this period are the studies that define the existence of learning disabilities in hospitals and institutions. In the 1940s and 50s, the transition phase focused on the idea of the classroom and new educational ideas were developed. In the unification phase, from 1962 to 1975, learning disabilities were defined for the first time, and political factors encouraged different groups to unite in one field. Between 1975 and 1988, defined as the development phase, the provision of services for many children diagnosed with learning disabilities was secured by legislation. The decline phase covers the years 1988-2001. In this phase, proposals for inclusion classes were made due to the lack of an adequate

definition and the increase in the number of diagnosed children. The last phase, the restructuring phase, covers the years from 2002 to the present and focuses on changes in policy (Bender, 2012). The diagnosis of children with SLD focuses on the inconsistency between intellectual abilities and achievement (Kirk et al., 2014). Therefore, the diagnosis of these children coincides with primary school years. However, it is also possible to catch the symptoms of children with SLD in early childhood. Below, the definition of SLD is given, and then the symptoms in early childhood are presented.

SLD and Its Symptoms in Early Childhood

The diagnosis is made by focusing on the difference between the abilities (intelligence) and achievements of children with SLD. Therefore, the majority of children with SLD can be diagnosed during the school period (Kuzgun, 2019). Although there are many symptoms of SLD in early childhood, it is not thought that the child may have SLD due to the lack of information about this process (Okur, 2019). However, many symptoms related to learning difficulties can be observed in early childhood. According to studies, these symptoms include disorders in spatial semantic processes, visual and tactile processes, auditory and balance, and motor control in early childhood. There are symptoms such as not speaking in sequence with the correct word structure expected for acoustic memory problems, difficulty in understanding the stories read aloud, confusing essential words (such as running, giving, eating), and loss of interest in sound (such as repetition and spelling) games. Visual memory impairment is a sign of visual memory problems in symptoms such as difficulty in drawing geometric shapes.

Communication and language characteristics are more evident in the pre-school years. Problems such as learning to speak late, inability to pronounce the pronunciation of words, frequent articulation problems, confusing words containing sounds close to each other while speaking, and changing the location of syllables are encountered. Difficulty in distinguishing the shape and number drawn on the palm of the hand when the eyes are closed, discrimination problems by touch, delay in language development, often babyish speech, and difficulty in rhyming words are other signs of language problems. Difficulties in learning concepts such as wearing shoes backwards, holding the book upside down, front-back; orientation problems; symptoms such as liability of emotions, weak body image, communication problems with peers, introverted, aggressive, anxious behaviors and inability to adapt to rules are the symptoms of social, emotional behavior problems (Aslan, 2015; Commodari, 2013; Okur, 2019; Snowling, 2005). In addition, it has been observed that many children with reading difficulties due to SLD have language deficiencies that can be detected before they start reading (Lely & Marshall, 2010).

All these symptoms show that children at risk for SLD can be recognized in early childhood. Early detection of SLD can prevent many difficulties that the child may experience both academically and socially. Early diagnosis is very important for eliminating the obstacles that the child may encounter and for an independent life where he can contribute to society (Cortiella & Horowitz, 2014). Early provision of additional educational support after diagnosis will bring positive results for the child (Bailet et al., 2011). Today, research on catching the early signs of SLD in early childhood attracts attention (Nind et al., 2010; Timbó et al., 2019).

Purpose of the Study

When the literature is examined, it is seen that there are studies on different subjects related to SLD with teachers. The first of these issues is the intervention studies for preschool children who are at risk for reading difficulties (Al Otaiba et al., 2005; Bailet et al., 2013; Piasta et al., 2023). In these studies, intervention programs developed by the researchers are applied to children in the preschool period. When the literature is examined, the other subject that is emphasized about SLD is the examination of the opinions of teachers working at different levels on this subject and the studies on the determination of SLD (Fırat & Koçak, 2018; Flores et al., 2022; Kakabaraee et al., 2021; Krischler et al. 2019; Sousa et al., 2016; Sideris et al. 2008; Wight & Chapparo, 2008; Yaşa & Çiyiltepe, 2024). However, very few studies have been found examining preschool teachers' views and knowledge levels about SLD (Ertaş, 2022; Mullikin et al., 2021; Ramli et al., 2019). However, these studies only focus on dyslexia. However, as mentioned above, there are four subtypes of SLD. It is extremely important for preschool teachers to notice early symptoms to inform parents and primary school teachers. As it is known, preschool children are not diagnosed with SLD. However, as mentioned above, intervention programmes can be applied to preschool children with symptoms of learning difficulties. Apart from intervention programmes, teachers can make individual teaching by noticing the signs of SLD in children. In addition, the following article is included in the Twelfth Development Plan: 'An e-student file will be created in which each student's record of academic and social activities will be kept, and the learning process will be monitored across levels.' By recognising the

early signs of SLD, preschool teachers can write informative messages in these files and ensure that primary school teachers take the necessary precautions. For this reason, this study, it was aimed to examine the views of preschool teachers about the characteristics of SLD, what to do when a child is suspected of SLD, and whether SLD can be diagnosed in early childhood. For this purpose, answers to the following questions were sought:

- What characteristics do preschool teachers think children with learning disabilities have?
- What do preschool teachers do when they suspect a child has a learning disability?
- What do preschool teachers think about detecting learning difficulties in early childhood?

Methods

Research model

This research was carried out with a qualitative research design to examine preschool teachers' views about learning disabilities. Qualitative research design is a research approach in which qualitative data collection methods such as interview, observation, and document analysis are used, the detailed and realistic aspects of the research problem and phenomena are revealed in their natural environments, and the subject is analyzed in depth (Yıldırım & Şimşek, 2018). This research was designed with the basic qualitative research model, which is one of the qualitative research methods. The aim of basic qualitative research is to understand how individuals interpret their lives and experiences (Merriam, 2018). The purpose of selecting the basic qualitative research in this study is to analyse teachers' knowledge and opinions about the symptoms of learning disabilities in depth.

Study Group

The study group of this research consists of 19 preschool teachers. Snowball sampling, one of the purposeful sampling methods, was used to determine the teachers to participate in the research. Purposeful sampling methods have emerged within the tradition of purely qualitative research, and this method allows for the in-depth study of situations that are thought to have rich information. For this reason, purposive sampling was preferred in this study. Most of the teachers participating in the research are female (f; 17). 6 of the teachers work in an independent kindergarten, 7 in a kindergarten attached to a primary school, 3 in a kindergarten affiliated with a secondary school, and 3 in a private kindergarten. Fifteen of the teachers took special education courses, and 11 took the inclusive course. None of the teachers participated in training on learning disability separately. Eight of the teachers suspect that there are children with learning disabilities in their class. Teachers stated that the reasons for suspicion were difficulties in understanding the instructions, difficulty in learning numbers, writing numbers backwards, insufficient socialization, forgetting quickly, short focus, and late learning.

Data Collection Tool

In the research, structured interview questions prepared by the researcher were used as a data collection tool. While preparing the structured interview questions, first, the relevant literature was scanned, and William Bender's book named “Individuals with Learning Disabilities and Their Education” was used. Open-ended questions were prepared by the purpose of the research. The prepared questions were presented to an expert academician in the preschool department, and expert opinion was taken. Necessary corrections were made to the questions in line with the expert opinion.

Demographic Information Form

In the prepared paper, the teacher's gender, age, professional seniority, last level of education he graduated from, the type of school he works, whether he has taken special education and inclusion courses, whether he has attended training on learning disabilities, whether there is a child in his class who suspects that he has a learning disability, if there is such a child, the child There are questions about their characteristics and whether there is a child with a diagnosis of learning disability in their class.

Interview Form

In the interview form, there are structured interview questions in which teachers can explain their views on the definition of learning disability and their approach to children with learning disabilities, and who are at risk.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Ondokuz Mayıs University Social Sciences and Humanities Research Ethics Committee (Date: 25.02.2022, Number2022-125)
- Informed consent has been obtained from the participants.

Data Collection and Analysis

The interview took place in environments where preschool teachers could express themselves effectively and comfortably. Due to the pandemic process, the interviews were held online or face-to-face at schools, depending on the teachers' wishes. Before the interviews with the teachers, the purpose of the research was explained to the teachers, they were informed about the research, and with the consent of the participants, the interviews were audio

recorded. The researchers transcribed the audio recordings taken. After the data were transcribed, the analysis was started.

The content analysis method was preferred in qualitative data analysis of the data obtained within the scope of the research. The main purpose of content analysis is to reach concepts and relationships that can explain the collected data. While data are summarised and interpreted in descriptive analysis, in content analysis, data are subjected to deeper processing and concepts and themes that cannot be noticed with a descriptive approach are identified (Yıldırım & Şimşek, 2018).

Validity and Reliability

The credibility of the results in research is among the essential criteria of scientific research. Validity and reliability are the most common criteria used in research. In qualitative research, validity and reliability are ensured by the realization of credibility, transferability, confirmability, and consistency criteria (Yıldırım & Şimsek, 2018). In this direction, detailed description, purposive sampling, and consistency methods were used in the research to increase the transferability. Direct quotations from the views of the participants were frequently used for a detailed description. Thus, it is aimed to ensure that the research results can be examined in more detail. By choosing the maximum diversity case sampling, a study group was reached that would better reflect the research problem. In order to ensure consistency, the researcher read the raw data at two separate times, and codes were created. Then, he compared the codes he created separately. As a result of this comparison, it was concluded that all of the codes, except for two, express similar things and the final codes were determined.

In the research, it was aimed to increase the internal validity with credibility. In order to increase credibility, the method of diversification and expert examination was used. In the diversification method, the researcher paid attention to the fact that the teachers with whom he would interview were held in different school types and that there were differences in their professional seniority. In the expert review method, the researcher had a person who is an expert in the field systematically examined what he had done during the research and gave the final form to the research questions, interview questions and other dimensions of the research with the feedback he received

Results

In this study, the views of preschool teachers on the characteristics of SLD were examined under three headings: what they will do when there is a suspicion of SLD about a child and their views on the detection of learning disabilities in early childhood. Detailed findings on this subject are presented below.

Preschool Teachers' Opinions on the Characteristics of SLD

When the answers given by the teachers participating in the research regarding the characteristics of SLD are examined, it is seen that they are divided into two categories: literacy skills and developmental characteristics. These categories are presented in Figure 1.

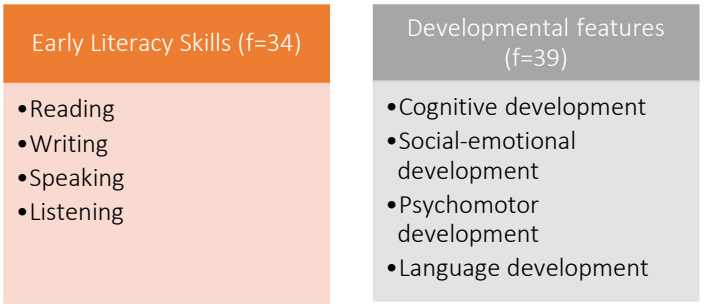

Figure 1.
Preschool Teachers' views on the Characteristics of SLD

When Figure 1 is examined, it is seen that teachers focus on all of the reading, writing, speaking, and listening skills under literacy skills. When the answers given are examined, it is seen that preschool teachers generally focus on difficulties in reading, writing, speaking, and listening.

Regarding this issue, T.15 stated his opinion: "*Children with learning difficulties have difficulty in speaking, listening, reading-writing and math operations and cannot fully acquire these skills.*" In addition, it was determined that the teachers focused on reading backward, writing incorrectly, writing numbers backwards, and having difficulties in expressing themselves. T.10 related to this *issue "…Some children read backwards, mixed up the words and read. Some children write wrong…"* stated her opinion. T.8, on the other hand, focused on *"…Write letters and numbers backwards…" in a similar way. Some teachers focused on these children's difficulties in expressing themselves."* Regarding this issue, T.9 *"… Inadequacy in socialization and difficulty in self-expression can be seen."* She expressed himself.

When the answers given by the teachers regarding the

developmental characteristics are examined, it is seen that there are four categories: cognitive development, social-emotional development, psychomotor development and language development. When the answers given by the teachers about cognitive development were examined, it was seen that they generally focused on having difficulties in mathematical skills. Regarding this issue, T.18 *"…. Then it could be that he couldn't match symbols in math."* She has expressed her views. T.9 says: *"… They lag behind their peers in math activities."* She expressed her opinion. Apart from mathematical skills, teachers focused on late learning and difficulties in problem-solving about cognitive development. Regarding this issue, T.2. *"… problem-solving, reasoning, etc. They have difficulties in using skills in these areas."* she has expressed her views. T.5 said, *"Not all areas of development are problematic. Net has specific problems in learning. I even remember that some of them are clearly more talented in other areas."* expressed her views.

Another development area that teachers focus on is social-emotional development. Teachers stated that children with SLD are shy about this area. T.12 said, *"Children with learning disabilities are socially shy. They often play separate games from their friends. They avoid communicating with them."* she said. In addition, teachers emphasized that children with SLD are insufficient in socialization. T.9 on this *subject "… low self-esteem, inadequacy in socialization, difficulty in expressing oneself can be seen."* she expressed his views.

The focus of preschool teachers regarding psychomotor development is difficulties in these skills. T.1 is related to this subject as *"…There is also weakness in psychomotor skills." she has expressed his views. In terms of language development, teachers generally focused on language development, apart from literacy skills."* T.19 expressed her views on this subject as *"… their language development is behind their peers…"*.

What Teachers Do/Will Do in SLD Doubts

The behaviors of the teachers participating in the research when they have a child suspected of having SLD in their classroom are divided into two categories as classroom practices and interviews. These categories are presented in Figure 2.

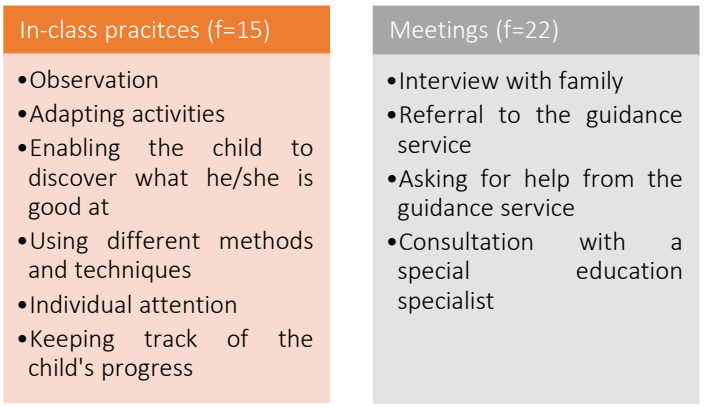

Figure 2.
What Teachers Do/Will Do in SLD Doubts

When Figure 2 is examined, it is seen that the answers of the teachers participating in the research are divided into two categories as classroom practices and interviews. In classroom practices, it has been determined that teachers will use observation, adapting activities, enabling the child to discover their best aspects, using different methods and techniques, individual attention, and following the child's progress; in the interviews, they will meet with the family, direct them to the guidance service, ask for help from the guidance service and consult a special education specialist. Some of the teachers included in the study stated that observation should be a priority when there is a child in their classroom who they suspect has SLD. T.15 said, *"First of all, I observe for a long time. At least 3.5-4 months. If I remember correctly, there was an observation period of 6 months. If I see a risky situation in my first observations, I ask for help from the school counsellor…"* Teachers also emphasized the necessity of adapting the activities in addition to observation. T. 19 is about this subject*: "I prepare appropriate instructions for the child in the classroom so that he can understand me, understand the activities, and actively participate, and I try to adapt the activities I have planned for them."* She has expressed her views. Teachers also stated that they would help the child discover their strengths, use different methods and techniques to ensure active participation of the child, take individual interest and follow the child's progress. T.17 *"First of all, I use different methods and techniques. After finding which method and technique suited them, I would keep the things taught during the day less, but the time more."* T.19 stated her views as *"I would regularly observe the child and see how far he/she has progressed and whether the adaptations and individual activities I made for him were working."* expressed her views.

When the answers to the interviews were examined, it was determined that all teachers would interview the parents. T.15 *"…I also get information from the family after the first*

observation process, but I do not express my doubts. Finally, due to the information I received from the family and the observations I made with the guidance teacher, I reach a common decision and inform the school administration and the family. Then the Guidance Research Center process begins." T.9 *"I start to make detailed observations, and if my doubts have increased, I will interview the family so that I can learn the situation better from them."* expressed her views. In addition, teachers stated that they would get help from the guidance service in this process." T.15 said, *"...If I see a risky situation in my first observations, I ask the school counselor for help. This aid is not to send it to Guidance Research Center immediately, but rather to intervene early in risky situations by making a joint and quicker decision...".* T.2 says, *"I send it to the guidance service and follow the scanning and diagnostic processes. If my diagnosis is correct, I will prepare an IEP and train the child accordingly."* she has expressed her views.

Teachers' Opinions on Identifying Learning Disabilities in Early Childhood

While most teachers participating in the research thought that learning disability can be identified in early childhood, few teachers were undecided on this issue. T.10, one of the teachers who think that learning disability can be determined in early childhood, *"It can be detected. We provide basic information such as addition, subtraction, or problem-solving in mathematical operations. Some children can write or read their names, so we can be suspicious. But I think the rest of the literacy processes will emerge more clearly in primary education."* T.18, one of the teachers who were undecided while expressing their opinions in the following way, said, *"So it can be detected? Actually, I think it's a process. For example, at the beginning of the year, children often come back as unable to do these skills. For example, using scissors, counting and writing. But at the end of the term, after receiving a certain education, it may be if he still cannot do these skills and there is no development in the child. Actually, I think the teacher and family are important here. If the teacher and the family are excellent observers and work in cooperation, but there is no improvement in the child, I think the diagnosis can be made in the pre-school period. I'm not sure, but that strengthens the possibility."* T.6 *"It depends on the age group of the child. Children start from the age of 3. Three yes may be a very early age. I would say maybe 4. But it is common to notice such a situation in a 6-year-old child. Because there is only a month difference between them and primary school, it can be detected at the age of 5,5-6, especially by an expert".*

Discussion

Specific learning disorders are characterized by difficulty learning key academic skills. In a study conducted by Bozatlı et al. (2024), 515 children were screened and SLD risk was found in 5.7% of these children. Children at risk of having SLD may exhibit some preliminary symptoms in earlier periods. The symptoms that may be observed in early childhood can be seen in areas such as reading, speaking, motor skills, and predicting skills (Okur, 2019). For this reason, it aims to examine preschool teachers' views on learning disabilities.

As a result of the research, preschool teachers' views on the symptoms of learning disabilities are divided into two categories: literacy skills and developmental characteristics. Literacy skills include reading, writing, speaking, and listening. In a study conducted by Kocsis (2016), it was determined that classroom teachers had sufficient knowledge in the classification of reading, writing, mathematics, and verbal communication of learning disabilities. Developmental features include cognitive, social-emotional, psychomotor, and language development. When the literature is examined, it is seen that the symptoms of learning disabilities have problems in language development, reading area, written language, mathematics, social-emotional development, and psychomotor development. For this reason, it can be said that teachers generally have an idea about the symptoms of learning disabilities. However, during the research process, it was observed that teachers generally focused on the reading, writing process, and cognitive development. In the study conducted by Şentürk-Gülhan (2023), it was determined that as the symptoms of learning disability increased in preschool children, early literacy and executive functions decreased. Therefore, it is normal for the teachers participating in this study to focus primarily on skills related to early literacy. Because it primarily manifests itself in these areas. However, it is seen that the teachers participating in the study did not focus on symptoms in all developmental areas. However, other literacy and developmental areas also have an essential place in recognizing the early signs of learning disabilities. In the study, it was determined that teachers focused least on psychomotor development. However, the inability to acquire some skills in psychomotor development may be a symptom of learning difficulties (Flores et al., 2022). When the literature was examined, it was determined that children diagnosed with SLD showed different developmental characteristics in early childhood compared to their typically developing peers (Fırat & Bildiren, 2024).

For this reason, it is important for teachers to evaluate children in all developmental areas and notice their symptoms rather than focusing only on cognitive skills and difficulties in reading/writing. In addition, teachers did not mention the connection between SLD and other disabilities. For example, in the study conducted by Yaşa and Çiyiltepe (2024), it was determined that the likelihood of SLD in children with DLD was higher than in children with typical development.

When the teachers participating in the research are examined, it is seen that there are two categories when the child/children are suspected of having a learning disability: In-class practices and interviews. When the answers they gave about the in-class practices were examined, it was determined that the following items were/will be done. Observation, adapting activities, enabling the child to discover their good points, using different methods and techniques, individual attention and following the child's progress. When the literature is examined, it is not recommended that children should be evaluated with different assessment techniques for a certain period before they are diagnosed and that different teaching strategies should be used. At this stage, which is called the pre-submission process, it is aimed to ensure the active participation of children in the class before the detailed evaluation process (Yazıcı et al., 2020). In a study conducted by Yazıcı et al., it was tried to determine the stages that preschool teachers and pre-service teachers will take in the pre-posting process. As a result of this research, it was seen that preschool teachers and teacher candidates primarily focused on observation. Then, it was determined that they would try to increase the active participation of children with different instructional strategies. In this study, it was determined that teachers focused primarily on observation and then on instructional adaptations. Similarly, in the study conducted by Morningstar et al. (2015), it was determined that teachers would apply different methods. The second theme that teachers' focus meetings. It has been determined that teachers are/will be in contact with parents and guidance services. Similarly, similar results were obtained in the studies conducted by Mulholland and O'Connor (2016), Nonis et al. (2016), and Yazıcı et al. (2020).

Finally, it was determined that all of the teachers included in the study thought that learning disability could be diagnosed in early childhood, either definitely or partially. Teachers think that it will be difficult to determine at the age of 3-4, but they think it can be determined at the age of 5-6. However, the difference between achievement and ability tests should be cleared in the diagnosis of learning disability. In Turkey, achievement tests are not applied because literacy teaching is not done in preschool education. For this reason, the diagnostic process does not seem possible. However, there are screening tools for recognizing the early signs of learning disability. By using these tools, it is thought that the areas that the child needs to be supported can be determined.

Conclusion and Recommendations

As it is known, learning disability is a developmental disability diagnosed in primary school years. However, signs of learning disabilities may appear in early childhood. For this reason, it is extremely important for preschool teachers to be aware of the early signs of learning disabilities. In this study, it was aimed to examine the views of preschool teachers about learning disabilities. For this purpose, the research was designed with the qualitative research method. However, only interviews were used in the research due to the ongoing effect of the pandemic and data were collected from one province. In future research, interviews can be made more comprehensive by adding observations.

As a result of the research, it was determined that some teachers had children in their classrooms whom they suspected of learning difficulties. In future research, a survey can be conducted with parents and teachers of children whose teachers suspect a learning disability.

Surveys can be conducted throughout the country.

Türkiye's XI. In the Development Plan, it is envisaged that screening will be carried out in childhood. In early childhood, screening for learning disabilities can also be performed with other developmental disabilities.

In the Twelfth Development Plan, e-learner files are mentioned. If this plan can be realised as soon as possible, cooperation between levels can be ensured. Thus, when children with SLD risk enter primary school, their teachers can have an idea.

Ethics Committee Approval: Ethics committee approval was obtained from Ondokuz Mayıs University Social Sciences and Humanities Research Ethics Committee (Date: 25.02.2022, No: 2022-125)
Informed Consent: Written informed consent was obtained from pre-service teachers who participated in this study
Peer-review: Externally peer-reviewed.
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Exploring the Impacts of Academic Writing Instruction on the use of Academic Writing Norms and Conventions: A Qualitative Study

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ABSTRACT

Writing is a far-reaching element which requires the efficient use of linguistic structures and rhetorical patterns for a more advanced writing proficiency. Similarly, producing academically acceptable papers might be challenging and frustrating for postgraduate students. In this respect, it can be a notably opportune time for L2 writing scholars and practitioners to illuminate the greater importance of the accurate use of academic writing norms and conventions for more effective academic papers. Therefore, this study aimed to investigate postgraduate students' perceptions regarding the impacts of academic writing instruction on the use of academic writing norms and conventions as well as their difficulties in the use of academic writing conventions when they write a research paper. This study adopted qualitative research design with a semi-structured interview format and textual analysis. A small-scale exploratory approach was adopted to help researcher to gain exploratory insights and determine key themes regarding the participants' view, experiences and suggestions. The participants consisted of postgraduate students in English Language Teaching department at a state university. A 14-week course was delivered to teach the accurate use of academic writing conventions. The students were asked to write a summary of an article chosen by the instructor at the beginning and end of the semester. After the instruction, data were obtained by interviewing the participants. The analysis of summaries written before and after the instruction was used to support the interview findings. The results revealed that the participants benefitted from the academic writing instruction in terms of using the academic norms and conventions in their research papers. They generally had positive attitudes toward receiving instruction focusing on academic writing norms and conventions. Based on the findings, it can be suggested that the postgraduate students have difficulties in academic writing; therefore, they need to receive comprehensive instruction, particularly to learn how to use academic writing conventions in their own disciplines.

Keywords: Applied linguistic**,** academic writing, higher education, postgraduate students.

Introduction

Academic writing is a touchstone in the scholarly community and intrinsic for the transmission of related inquiry and academic discourse. For postgradute students, the knowledge of academic writing norms and conventions is integral for generating high-quality and effective research papers. Therefore, recent years have seen a drive to regulate and maintain a standard and science-based model in assessing postgraduate academic writing such as master's theses and doctoral dissertations (Casanave, 2010). Although there is an expectation from academics to write more experimentally and innovatively rather than using conventional styles, Miller et al. (1998) assert that changes in the established forms of academic writing is not likely to occur. This is because supervisors and faculties tend to have expectations about how an academic text should attune to acceptable disciplinary norms and conventions, which means this is a requisite for postgraduate students (Muller et al., 2017). On the other hand, postgraduate students' writing skills are generally evaluated as insufficient for a research paper (Lin & Morrison, 2021). Poor writing skills may influence students' potential to generate credible and impactful scholarly texts, theses, and dissertations, resulting in their overall academic success.

With reference to this fact, several universities have designed English for specific purposes (EAP) courses in particular for postgraduate students (Rakedzon & Baram-Tsabari, 2017). These courses fundamentally aspire to improve postgraduate students' writing skills, enabling

them to gain more sophisticated and expected levels of academic language use (Storch & Tapper, 2009). Many researchers have investigated postgraduate students' academic writing skills with a focus on challenges in academic writing (Lin & Morrison, 2021), their perceptions on these skills (Aydin & Baysan, 2018), assessment in academic writing (Topping et al., 2000), supervisors' role in academic writing (Lee & Murray, 2015). However, a notable shortcoming persists in the investigation of the impacts of academic writing instruction on the accurate use of academic writing norms and conventions except for a few studies (Kaufold, 2015; Kaya & Yağız, 2023). Similarly, in Turkish context, significant body of research was dedicated to investigate academic writing-related issues in postgraduate education (Erturk, & Ozturk, 2022; Toprak & Yücel, 2020). To the best knowledge, on the other hand, these studies generally focused on difficulties in academic writing, which reveals a need for the investigation on the effects of academic writing instruction focused on norms and conventions among postgraduate students. Therefore, this study enlarges this line of research in the particular context of the effects of academic writing instruction on knowledge, skills and awareness of Turkish postgraduate students majoring in English Language Teaching regarding the use of academic writing norms and conventions. Their perceptions regarding the effects of instruction based on the accurate use of academic writing norms and conventions may provide valuable insights into academic writing research in several ways. Understanding their perceptions may help practitioners and instructors to identify niches and misconceptions regarding existing knowledge in academic writing, and address specific needs and expectations in postgraduate education. Also, postgraduate students may increase their awareness about the importance of maintaining high academic standards.

Compatible with these purposes, the research questions of this study were given below;

1. What are postgraduate students' perceptions about the impacts of the instruction regarding academic writing norms and conventions?
2. What are postgraduate students' perceived difficulties in academic writing within the Turkish EFL context?
3. What are the postgraduate students' needs and expectations about the improvement of their academic writing skills?

Literature Review

Academic writing is a habitual endeavor that many academics need to perform (Sword, 2011), and these practices are tied to common beliefs governed by research community (Badenhorst, 2018). From a social perspective, Hyland (2004) suggests that the success in academic writing depends on the integration of approved discourses of a particular social world into the writing process, which means that academic writing is the joint of writers' personal goals and shared professional discourses. Over time, these common practices may change subtly and invisibly, thereby it can be a fallacy for graduate students to think that academic writing is a skill which is once learned and does not require an ongoing effort (Badenhorst, 2018). That is why, formal training on stylish writing has become more common in recent years (Sword, 2011). This issue leads the way to investigating academic writing instruction-related issues more than it used to be. As such, this has been the driving force behind the rationale for this study.

Regardless of disciplinary differences, academic writing plays an important part in academic practice (Hyland, 2004). This is also applicable when written communication is considered as an opportunity to engage with the researchers within the same field. The shared discursive convention also paves the way for efficient communication with the readers (Patriotta, 2017). The dynamic nature of academic writing deserves great attention in scholarly community. Accordingly, there has been considerable research devoted to academic writing conventions over the past few decades. (Al Badi, 2015; Coffin et al., 2005; Hyland, 2008; Lillis, 1997; Thonney, 2011). The releavant literature unveils several studies handling this issue from different perspectives (Alostath, 2021; Castelló et al., 2009; Holmes et al., 2018; Huerta et al., 2017; Kaufold, 2015; Swales & Feak, 2012; Singh, 2019; Zhang, 2011).

Of the extensive research which has centered on postgraduate students within the context of academic writing, some studies are notably worth mentioning. The first one benefitted from both research and students' experiences (Swales & Feak, 2012). Therefore, this study is successful in addressing the most critical points in efficient academic writing, and with a variety of tasks and activities, provides assistance for graduate students. Considering the lack of formal training for L2 students (Hyland, 2016), such activities or tasks can be vital for them. Another important study was conducted by Kaufold (2015) who adopted a similar methodological approach with this study. The researcher reported findings obtained from the analysis of students' texts and interviews conducted with 12 graduate students from different social sciences departments. Aiming at exploring the links between students' prior experiences and their texts, this longitudinal study revealed striking findings which demonstrated that the students' understanding about the use of academic conventions

changed to a great extent, and they figured out that their bounded conventions could be reshaped using disciplinary and local ones. Also, they benefitted from their prior academic writing experiences to complete their theses as well as the explicit guidelines provided during the study. These results imply that explicit guidelines are helpful for the graduate students to write their academic texts but these guidelines may be interpreted under the influence of past experiences. Similarly, Singh (2019) conducted a study to explore the challenges of international postgraduate students, and the findings of her study indicated that students' previous experiences may not adequately prepare them to comprehend new academic norms and conventions expected in graduate programs.

With this in mind, it would be of great importance in considering how graduate students tackle their difficulties when they have little experience to write their theses and to meet the demands of academic community (Akbas & Hardman, 2018). In the related literature, there seems to be agreement on postgraduate students' difficulties in academic writing (Bronson, 2004). Particularly, the students who are non-native speakers of English find academic writing challenging (Casanave & Hubbard, 1992). Previous studies contributed to the relevant field by providing numerous reasons for academic writing difficulties. For instance, according to Brown (2008), both language barriers and the lack of knowledge regarding academic writing norms and standards pose difficulties for postgraduate students in academic writing. Among the difficulties that Singh (2019) explored in her study can be using acceptable academic style, developing coherent paragraphs and inaccurate use of English grammar and vocabulary. In accordance with the results of the above-mentioned research paper, Aunurrahman et al., (2017) conducted a text analysis to explore the students' academic writing competencies, and provide insights into the limitations of students such as mastering schematic structure, linguistic features, and organizing information. Approaching the issue from the perspective of graduate students' views, Alostath (2021) revealed similar difficulties that postgraduate students are in need of tackling in their academic writing, reporting that students' main problems were their limited proficiency in English academic writing and deficiencies regarding the use of academic writing style to construct arguments and claims. Despite these compelling obstacles, there is a dearth of support for graduate students in their programs (Sidman-Taveau & Karathanos-Aguilar, 2015). Therefore, more attention should be devoted to research on the ways to address the challenges faced by graduate students in academic writing. There has been considerable literature on academic writing related issues in Turkish context. Academic writing-related difficulties (Alnıjres, 2018; Ekoç, 2019), supervisor' role in academic writing (Şahin & Yağız, 2024), teaching academic writing in postgraduate education (Yuvayapan & Rathert, 2018), and postgraduate students' needs and expectations (Yuvayapan & Bilginer, 2020) have been among various important issues explored in Turkish context.

Despite the significant contributions offered by this area of research, diverse shortcomings are obvious in the studies reviewed. These design flaws lie in the lack of a longitudinal data to understand the long-term impacts of academic writing instruction (Yuvayapan & Rathert, 2018), limited sample size and reliance on only self-reported data (Tahıra & Haıder, 2019), inadequate attention to particular academic writing norms and conventions. Despite the extensive research on graduate students' competencies and challenges in academic writing in many different contexts, limited research has been conducted to understand the accurate use of academic norms and conventions in theses and dissertations in Turkish context (Çelik, 2020; Karakuzu et al., 2020; Öztürk & Köse, 2016; Toprak & Yücel, 2020; Yucelsen et al., 2015). Keeping this in mind, the significance of this study is accentuated by its potential to emphasize the niches in the existing studies on academic writing in postgraduate education. In this study, it is expected to provide valuable insights into the understanding of the perceived impacts of academic writing instruction on the use of academic writing norms and conventions. Thereby, it is aimed to present a thorough and detailed framework for developing academic writing instruction in order to enhance postgraduate students' academic writing skills.

Methods

Research Design

This study is based on the data obtained from an academic writing course for postgraduate students., a qualitative research design congruent with the research questions of the study was employed in the current study. Given that there are few studies specifically centering on postgraduate students' perceptions and voices about the impacts of academic writing course based upon academic writing norms and conventions on their writing skills, the current study adopted an interview-based qualitative approach to explore postgraduate students' conceptions about this issue. Semi-structured interviews are particularly effective in eliciting in-depth, nuanced data and enable researchers to explore educational practices and experiences (Merriam, 1998).

In-depth interviews are used to obtain comprehensive and

detailed data related to participants' views, experiences and perspectives about a new or under-researched topics. Accordingly, this study employed a small-scale exploratory approach which help the researchers gain exploratory insights and determine key themes, which may pave the way for further larger-scale investigations. Textual analysis based on the summaries written by the students before and after the instruction they received was also carried out to support the data collected with the interviews.

Participants

This study adopted purposive sampling to select the participants. This technique is an appropriate choice when the researcher aims to gather convenient and favorable data for an in-depth understanding (Kelly, 2010; Palinkas et al., 2015). Seven postgraduate students participated in the study. They were enrolled in postgraduate programs of English Language Teaching department as MA and PhD students. The course delivered within the scope of this study was devoted to teach norms and conventions in their own disciplinary academic writing. Although there were more students who were enrolled in this course, some students did not complete all the tasks during the semester. Thus, only the students who consistently participated in the lessons and completed the assignments given prior to and after the instruction process were selected as the participants.

Data Collection Tools

Aiming to explore postgraduate students' perceptions about academic writing instruction, and their needs and expectations in this regard, the study conducted semi-structured interviews. The questions were prepared to reveal participants' perceptions about the efficacy of receiving academic writing instruction, and the impacts of receiving feedback to improve their writing skills. There were 12 questions which were prepared by the researcher (Appendix A). To ensure the reliability and validity of the instrument used in this study, the researcher developed a detailed interview guide involving a clear set of questions and prompts compatible with the research purposes. Similarly, pilot interviews were conducted with two participants prior to the main study to test and refine interview questions. Feedback from the pilot study was used to improve the questions. Also, the participants were responsible for writing summaries of two research papers before and after the instructional process. Based on the analysis of their first and second summaries, they received feedback to identify their mistakes and errors in terms of using academic writing conventions and to answer the interview questions about the efficacy of feedback and instruction.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Atatürk University University Educational Sciences Ethics Committee (Date: 06.09.2022, Number: E-61570131-100-2200269918)
- Informed consent has been obtained from the participants.

Procedure

Before the delivery of academic writing lessons, all participants wrote a summary of a research paper using their background knowledge and experiences. Then, the students took academic writing course which was designed as 42 class periods in a 14- week semester. The content was prepared to ameliorate the postgraduate students' academic writing skills, their knowledge and awareness about the accurate use of norms and conventions in academic writing. Several textbooks were used in the design of teaching materials. Following the instruction process, the students were asked to produce a summary of a different research paper to compare their first and second texts and to give feedback about their progress in using academic writing conventions accurately. After the fulfillment of the semester, the interviews were conducted to figure out the participants' conceptions about to what extent they benefited from the instruction that they received.

Data Analysis

Because the instruction pointed out the important aspects of acceptable academic writing such as formality, accuracy, connectedness, and paraphrasing, the participants' texts were analyzed in terms of using a formal and accurate use of language as well as effective paraphrasing, referencing, and hedging. The analyses were conducted in two cycles. The first one involved a detailed reading of the summaries for the preparation of instruction content and interviews. Errors and mistakes in each text of the participants were identified to give feedback and to compare with the texts written after the instruction. The analysis of the final texts focused on the occurrence of these aspects in an accurate way. Multiple rounds of analysis were carried out to assure the reliability of the data. Cross-checking results were included based on the established academic writing norms to reduce potential biases. Also, a subset of analysis was reviewed by an independent expert for the validation and reliability of the findings.

As for the analysis of the interviews, thematic analysis was employed. Thematic analysis, which is a type of qualitative research, provides themes based on the codes derived from the qualitative data set. It is an appropriate way for the studies which aim to analyze the data in detail using

studies which aim to analyze the data in detail using interpretations (Alhojailan, 2012). The data was analyzed using Braun and Clark's (2006) six phases. According to Braun and Clark (2006), firstly, the researcher familiarizes with the data. Second phase requires generation of initial codes. After the researcher searches for themes, these themes are reviewed, defined, and named. As for the last phase is the production of the report. Based on these phases, the researcher transcribed the interviews verbatim and reviewed the transcriptions a few times to become acquaintant with the data. After the review of the transcriptions, the codes were identified and categorized under the themes.

Results

For a general understanding of participants' perceptions of their scholarly writing skills, the impacts of instruction devoted to academic writing conventions, and the role of feedback in improvement of writing skills, semi-structured interviews were carried out with participants. Therefore, the data obtained from the interviews through content presented a general insight into how participants deal with academic writing skills and challenges in their discipline and what the perceived impacts of academic writing course on their skills and knowledge. The analysis of the data collected from participants was classified under four main themes.

The thematic analysis of the interviews with postgraduate students revealed four main themes including "*Perceived impacts of academic writing course on postgraduate students' knowledge and skills", "Awareness of feedback", "Postgraduate students' ongoing challenges in using academic writing norms and conventions",* and *"Suggestions for improving knowledge, skills and awareness in academic writing".* Figure 1 demonstrates the themes identified through thematic analysis.

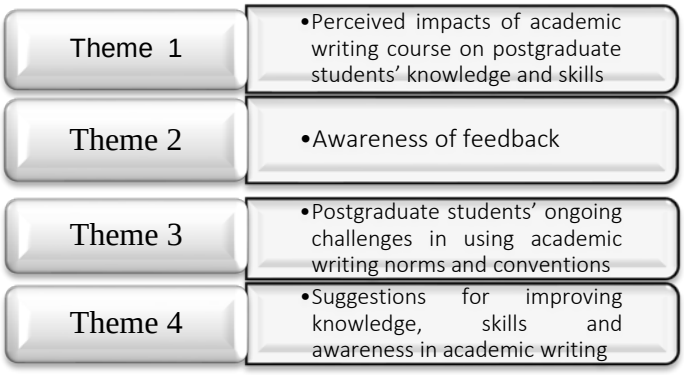

Figure 1.
Themes obtained from Interviews

Theme 1: Perceived impacts of academic writing course on postgraduate students' knowledge and skills

The first theme centered on postgraduate students' perceptions about the effects of instruction devoted to academic writing norms and conventions on their improvement. In this respect, the findings displayed a positive relationship between the training of academic writing norms and conventions and improvement in students' perceived writing performance. All of the participants uttered that the instruction they received contributed to their writing skills to a great extent. 6 out of all participants stated they did not receive such an instruction, thereby they had a lack of essential knowledge and skills regarding effective academic writing when they were enrolled in postgraduate program. Most of the participants were delivered writing course when they were undergraduate students; however, the content was not comprehensive and detailed enough to write a research paper. P1's utterances exemplify the lack of content of the literatue review writing courses for the improvement of essential literatue review writing skills as following:

I took a writing course at the undergraduate level, but this course was not that comprehensive and detailed. We were taught only how to write an essay. Therefore, the academic writing course that we received this semester contributed a lot to my academic development. More importantly, my viewpoint about effective academic writing has changed in a positive way. My awareness regarding the accurate use of academic writing norms and conventions has considerably increased.

With regard to academic writing norms and conventions, most of the participants agreed that the instruction enabled them to acquire certain aspects of academic writing. Hedging, formality, and paraphrasing are the most frequently mentioned ones among all the conventions. According to the participants, the texts which they produced were somewhat more informal and they did not know how to effectively use hedging devices and paraphrasing techniques prior to the instruction. To quote this, P4;

> I realized the criticality of academic writing instruction in postgraduate education to get familiar with the conventions expected in our field. I was not familiar with hedging before this training, that is why, this training was very helpful to learn discipline-specific norms and conventions.

Another striking finding obtained from the data was the positive effect of the instruction on students' self-confidence. P7 had an impression that they lacked the expected skills for effective writing, and thereby, they were not self-confident when writing an academic paper. In relation to this, P5 uttered that "More importantly, the instruction that we received increased our self-confidence". Two participants particularly highlighted the importance of the assignments for the improvement of writing skills. For them, the assignments they completed during the courses was informative since the assignments offered them many opportunities to practice what they learned in the lessons.

The analysis of the academic papers written by the students prior to and after the instruction confirmed the interview results. On the basis of the analysis, some examples from the texts can be offered to support the participants' perceptions. The analysis of the first texts revealed a variety of informal statements and an informal language in the texts created by the participants. The use of contractions, personal pronouns, direct questions and informal words or statements were the most common examples for the lack of knowledge about the use of formal language. The following sentences extracted from the participants' texts can confirm this finding;

"Learners shouldn't imitate or speak as like native speakers, but they should adapt their speech appropriate for non-native speaker." (P3)

"However, researchers are not allowed to get accesses if they don't have any specialized knowledge of phonetics." (P6)

"I agree with this statement completely." (P7)

"In conclusion, what should be done to correct the problems and misunderstandings?" (P1)

A close reading of the texts indicates that the students also expressed absolute certainty and made over-generalizations, which means they were deprived of the knowledge regarding the correct use of hedging devices in academic papers. For instance, P7's utterance "There are always non-native speakers' accents which are different from each other." can be evaluated as a strong claim in academic discourse. Similarly, the overuse of passive voice and punctuation mistakes are evidently unacceptable in academic writing, which the students had weaknesses in the use of these conventions. P2, for example, repeatedly used passive voice in her text. The following extract from P2's text shows the overuse of passive voice in consecutive sentences in the same paragraph, and underpins the need for more attention to the use of passive voice in academic writing accurately:

> It is stated that not only the method of pronunciation teaching but also teaching grammar and vocabulary is generally based on common-sense intuitive notions. It is also mentioned that pronunciation teaching depends on tutors' experience and impressions about language teaching which causes to some obstacles and not to be able to find the solution for the problems encountered. For that reason, it is indicated that empirical studies make clear about pronunciation instructions for tutors. In this article, it is mainly emphasized on countries where English is spoken as second language such as North America, Australia, Britain and New Zealand have their concerns about mutual intelligibility, miscommunication and language-based discrimination.

The first array of examples illustrated findings around the frequent misuse of academic writing norms and conventions among the postgraduate students. The second array of examples, on the other hand, displays how the academic writing instruction positively influenced the use of academic writing conventions by the students. The participants, during the interviews, emphasized their satisfaction with the positive effects of the instruction on their writing. The text analysis revealed results in accordance with the students' perceptions. The analysis results showed differences between the texts written before and after the instruction. The language of the texts produced after the instruction was noticeably more academic than those written at the beginning of the semester. The participants were able to utilize more linguistic resources to hedge their claims, and avoid using informal language. More importantly, they displayed better writing skills in using academic writing conventions. P3, who frequently used contractions in her first draft, did not make such errors in her second text: "In terms of the case, a significant difference is not observed in the control group.". Similarly, P7 softened his claim by using a hedging device, and wrote that: "Regarding first languages' different orthographic features such as alphabetic, logographic and syllabic language, readers from different L1 backgrounds may not have experienced the same decoding processes while reading English".

In addition, the participants displayed improvements in paraphrasing, referencing and connectedness in their papers. These findings imply that academic writing is a skill

which requires training, and academic writing conventions can be developed through practice including reading and writing tasks. Therefore, the need of students and expectations of their faculties from the students must be taken into consideration in postgraduate programs.

Theme 2: Awareness of feedback

This study yields important findings regarding the effectiveness of feedback in improvement of postgraduate students' writing skills. The analysis of the interviews elicited that almost all of the students found feedback to be critical to improve their writing skills. They stated that they benefitted from the instruction devoted to academic writing conventions through feedback. According to many participants, feedback provided information about the convenience of their writing product. P2 explained the importance of feedback for their development as follows:

> Feedback that we received during the semester increased our efforts to produce higher quality texts. Because feedback is compatible with the writing experience and thereby, I felt like the instructor monitored our writing experiences by giving feedback, which promoted learning the conventions more effectively.

Accordingly, P4 believed that postgraduate students should receive feedback to cope with their challenges, and added "The academic writing course should offer writing activities and tasks combined with feedback". This finding shows that he regards feedback as an inseparable part of writing instruction process. Supporting P4's ideas, P6 emphasized the significance of feedback in writing process with the subsequent statements:

> I think feedback became a very important part of writing instruction that I received. Because I think feedback represents the current situation of students' writing development. Based on the feedback I received in each assignment; I was able to easily see my deficiencies and this helped me understand on which conventions I needed to focus in subsequent tasks. In a sense, feedback serves as a guide in writing instruction process.

In a similar vein, P5 commented on the necessity of feedback for better writing skills and stated that feedback shows the gap between the existing and expected level of the students' performance; therefore, it fosters better writing skills by providing the students with the opportunities to deal with the challenges faced in their writing process. One of the participants (P7) approached the issue from a different perspective and uttered that:

> Academic writing course is a very important course that not only facilitates learning in this course but also helps the students complete the tasks and assignments in other graduate courses. For this reason, when I was preparing my assignments in other courses, I always remembered positive and negative feedback I received in this course, and tried to write my papers benefitting from what I learned from the lessons and feedback in academic writing course.

Another striking finding was presented by P3 who referred to a perspective on the contribution of feedback to students' affective issues. According to this participant, receiving feedback is an indicator of the teachers' attitudes toward the students. When the instructors provide feedback, the students may feel the support of their instructors for their development, and this may increase their motivation and self-confidence for learning from their mistakes and errors, and for improving their writing skills. P3 explained her beliefs as following:

> At the very beginning of the semester, I did not know the instructor's teaching style, that is why, I was worried. However, as she gave feedback for our papers, I felt that she cares about us and this increased my motivation and self-confidence, and encouraged me to work on the most challenging conventions. Therefore, feedback is very significant in academic writing course.

To sum up, the second theme mentioned above emphasizes the significance of feedback for the postgraduate students. The students generally stated that feedback is a cornerstone in academic writing course since feedback enables the students to realize their challenges and weaknesses regarding the academic writing conventions, and they can learn from their experiences.

Theme 3: Postgraduate students' ongoing challenges in using academic writing norms and conventions

The third theme deals with the ongoing challenges of postgraduate students when writing an academic paper. The interviews with the participants provide insights into their experiences when they wrote the second draft after the academic writing instruction they received. Whereas the students acquired new ways of writing an acceptable academic paper, they also dealt with some ongoing challenges. Of all conventions, vocabulary choice is one of

the most challenging conventions for the participants. A majority of the students remarked that academic writing is a difficult task and indecision about word choice makes this process more complicated. When they were writing their second texts, they had to struggle with using accurate synonym, correct use of prefixes and suffixes, and using relevant conjunctions. This finding coincides with the results obtained from textual analysis. The sentence taken from P1's text provides evidence for this consistency. The student wrote " …So, there was not any enterprise to separate either NSs or NSSs in terms of gender and age." in her text. In this sentence, the conjunction "so" is accepted as an informal word in academic discourse. The same participant, in the interview conducted after the intervention, expressed that she had great difficulties in word choice when she wrote her second paper. The participant extended her speech by stating that:

> When I paraphrased other researchers' ideas, especially, if the language was difficult to understand and if I had to find synonyms for the words which I was not familiar with, it was really difficult to find synonyms for those words. I could not be sure whether I gave the same meaning with the synonyms that I used.

The second challenging convention frequently reported by the participants was referencing and citation in academic writing. Some participants expressed their ongoing difficulties when they referenced other sources which supported their claims. In their first drafts, almost all participants made mistakes when they provided in-text citation, and direct and indirect quotations. The report of the first texts unveiled a great number of errors and mistakes in referencing the previous studies, which proved that many of the students had major problems with this convention. The number of the mistakes and errors in referencing significantly decreased in their second drafts. The students to a great extent became familiar with the accurate ways of referencing, giving citation, and quoting through teaching practices; however, two participants still made mistakes in referencing in their second drafts. As an example, P3 gave the page number of the source text although she did not quote an idea from the source text, but only paraphrased the idea. In addition to the mistake related to the page number, the participant made mistake about the place of date as shown below:

> In context, the usage of intensifiers is opposite to hedges mentioned previously. Leech has stated that overstatement might be unsuitable in formal written texts. (1983, p. 148).

P4 shared similar obstacles reporting that "I still have problems in referencing. I feel inadequate myself in this respect. Sometimes, I want to reference another source, but I hesitate to plagiarize". An extract from his paper confirms his fears. The participant unknowingly plagiarized since he did not include the date of the source text in his text "Jordan's book which is for teacher of academic writings, has an important section for a classification of hedges". Also, wordiness, repetition and hedging are still challenging conventions for the participants

The third theme of this study shed light into the ongoing challenges of the postgraduate students. Based on the interpretation of the findings, we can deduce that although the participants substantially learned academic writing conventions through the instruction they received, they might need more practice to become effective writers.

Theme 4: Suggestions for improving knowledge, skills and awareness in academic writing

All of the participants reported that they benefitted from the instruction that they received in terms of improving their knowledge, skills and awareness development. They mostly suggested that academic writing course is neglected in many graduate programs; therefore, they called upon more attention to be trained postgraduate students for effective writing. When asked their suggestions for the improvement of writing skills, five students addressed the lack of supervisor support in their writing processes. P2 explained this lack with following statements:

> Supervisors generally do not provide formative or corrective feedback when their students write an academic paper. They do not guide the students for formal and accurate writing. Their expectations from postgraduate students are high, but most supervisors do not adequately support their students to meet these expectations.

Supporting this, another participant (P7) remarked that some supervisors are not competent enough to promote student writing. Two participants (P2, P6) complained that feedback provided by the supervisors is somewhat insufficient and not constructive. Also, the interviews revealed another important suggestion regarding the efficiency of the academic writing instruction. A majority of the participants believed that this course should be delivered during two semesters, and the topics should be discussed more thoroughly. Another suggestion related to the delivery of the course was the inadequacy of practicing tasks and activities. The participants reported that students should be promoted for more practical application of theoretical knowledge. According to the participants, the lessons in academic writing course should involve examples from acceptable and unacceptable research papers. They

also suggested that the faculty members need to encourage the students to read more for successful writing since they consider reading has a critical impact on their writing.

Discussion

This study aimed to discover the postgraduate students' perceptions related to the impacts of the instruction devoted to academic writing norms and conventions. The findings obtained by analyzing the interviews and texts written by the postgraduate students showed that the instruction delivered significantly contributed to the students' knowledge, awareness and writing skills. After the instructional process, the students produced higher quality of texts and they stated that their awareness about the accurate use of these norms and conventions increased to a great extent. Therefore, it is possible to argue that the intensive writing course, tasks, activities, weekly assignments, and feedback gave the postgraduate students the opportunity to develop their abilities in academic writing. These results lead way to offering appropriate support for postgraduate students who compete against the academic writing expectations of their faculties. It can be suggested to design well-suited content to address participants' needs and expectations. Also, their improvement throughout the instruction can reflect a high level of receptivity and engagement to the material; that is why, interactive and practical training can facilitate learning and retention.

Several studies in the relevant literature have provided inspiring contributions to the knowledge of the development of academic writing skills (Muller et al., 2017; Sidman-Taveau & Karathanos-Aguilar, 2015; Storch & Tapper, 2009; Wischgoll, 2017). For example, the findings of this study coincide with Storch & Tapper's (2009) results for graduate students. The researchers evaluated postgraduate students' writing based on a course of a semester and found that the students displayed improvement in using accurate grammar and academic vocabulary. This is similar to the higher quality writing results by the L2 graduate students in an intervention with the pre- and post-tasks devoted to writing an academic paper abstract and a press release (Rakedzon & Baram-Tsabari, 2017). The researchers reported improved academic and popular science writing skills and improvement in students' English language proficiency. In another study, Wischgoll (2017) tested an intervention in a computer-based learning environment including undergraduate and postgraduate students and found improvement in students' skills to write higher quality texts. Wischgoll (2017) also illuminated the positive effects of feedback on students' writing skills, which is compatible with the results of the current study. Consistent findings regarding the positive effects of feedback highlight the importance of constructive feedback mechanisms in instruction to guide and empower students in their development.

With a similar population to the one in Wischgoll's study (2017), Polio and Fleck (1998) supported the findings of this study since they reported significant improvement in students' writing performances as a result of a 15-week course. Specifically focusing on the effects of instruction on grammatical accuracy in academic writing, Muller et al. (2017) conducted an experimental study including an 8-week instruction and found that ESL doctoral students in the health sciences significantly improved their writing with comprehensive written language support. Feedback, in a similar vein, deserved attention in Ma's study (2018) which reported that the postgraduate students valued feedback as a key component in academic writing. As a general conclusion of all studies mentioned above, feedback can improve students' writing since it enables students to explore their inadequacies and thereby, the increase in their awareness for accurate use of conventions may lead way to write quality papers. Therefore, in disciplinary content courses, feedback should be provided to postgraduate students as a continual support.

The interviews with the postgraduate students were central in this study since they linked the texts written by these students and their perceptions about their writing performances. The second important point in this study relates to the awareness of students regarding the importance of feedback in their writing improvement. The results revealed an increased awareness of feedback as an essential part of academic writing course. In the matter of their experiences before and after the instruction they received, they stated that their understanding regarding academic writing conventions considerably changed. As the topic were discussed during the instruction, their writing skills were shaped by the use of disciplinary conventions. This result was supported by Kaufhold (2015), who concluded that the participants changed their initial understanding of conventions by using them for different functions.

The results regarding students' perceived challenges showed that the participants significantly had difficulties in word choice, which is consistent with the results of Zhang' study (2011) in which word choice was reported as the major challenge among the graduate students. In this

study, the students also identified the use of hedging devices and referencing as their ongoing problems in academic writing. Thereby, these imply that some students needed more instruction and practice for a better understanding of academic writing norms and conventions. Alostath (2021) seems to be unanimous on the similar difficulties experienced by postgraduate students since the researcher found that the participants in his study had difficulties in citation and referencing. On the other hand, referencing and citation were found as the least challenging conventions in academic writing for ESL learners in Al Badi's study (2015) as in the study reported by Singh (2019). These difficulties can be attributed to inadequacy of writing practices, the duration of instruction devoted to academic writing, and lack of supervisor guidance.

Supervisor guidance was identified as an important part of the students' academic writing improvement in this study. However, the participants shared their feelings about the lack of essential assistance as in the study conducted by Neupane-Bastola (2022). Bearing this in mind, these results suggest an urgent need to deal with supervisor guidance in postgraduate programs. Similarly, whereas the importance of feedback was noted by the students in this study, their access to feedback in their disciplinary courses and by their supervisors is not adequate and satisfying and for promoting students' writing should receive more attention. This implies a gap between the availability of feedback and the expectations of the students in these respects. This conclusion is confirmed by Ma (2018) and Alhojailan (2021) who strongly advocate the need for more efforts to provide contructive feedback to meet postgraduate students' needs and expectations in academic writing.

Conclusion and Recommendations

This study illuminated writing perceptions presented by postgraduate students within the context of a Turkish university. The issues related to the use of norms and conventions in academic writing postgraduate programs were explored. The results may provide beneficial implications for postgraduate students, supervisors, faculty members, and course designers who seek for solutions to postgraduate students' writing problems and difficulties. No one can deny that the postgraduate programs and the faculties expect high quality theses and dissertations from the postgraduate students. In this respect, the results can increase students' awareness about the demands of their faculties and enable the novice writers to analyze their own writing and discover their writing skills and inadequacies.

Another important implication of this study can be that writing courses in postgraduate programs should involve practices for students correct, specific, and subtle conventions of writing not only in general but also in their own fields or disciplines. When doing this, students' conceptions should be incorporated into the courses as well as the guidance of faculty members. In writing courses, the students should be offered various practice opportunities and provided a content to improve their understanding of academic writing conventions through the meaningful exposure to the accurate use of these conventions.

Limitations and Further Research

One of the limitations in this study is the sample size. For more comprehensive and generalizable results, further research is needed with more participants. In addition, the evaluation of students' writing development focused on only one text before and after the instruction. Keeping in mind that this situation may not clearly represent the students' writing skills, future studies which analyze a variety of texts are recommended. Also, this study adopted a qualitative design based on the interviews with the participants, the findings may not be generalized in other contexts; therefore, a mixed-methods design can provide more generalizable results.

Ethics Committee Approval: Ethics committee approval was obtained from Atatürk University Educational Sciences Ethics Committee (Date: 06.09.2022, Number: E-61570131-100-2200269918)
Informed Consent: Written informed consent was obtained from postgraduate students who participated in this study
Peer-review: Externally peer-reviewed.
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The Relationship Between Secondary School Students' English Speaking Anxiety, English Speaking Self-Efficacy and Personality Traits

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ABSTRACT

This study aims to investigate the relationship between secondary school students' English-speaking anxiety, English-speaking self-efficacy, and personality traits. Conducted as a correlational study, it involved 920 students from secondary schools in the central districts of Van, selected through the cluster sampling method. Data were collected using the "Five-Factor Personality Scale," "English Speaking Self-Efficacy Scale," and "English Speaking Anxiety Scale." The analysis employed Pearson Product-Moment Correlation Coefficient and stepwise regression techniques. The findings revealed significant interrelations among students' personality traits, English-speaking anxiety, and self-efficacy perceptions. Specifically, students' English-speaking self-efficacy and the personality traits of openness to experience, extraversion, neuroticism, and agreeableness collectively accounted for 27.1% of the variance in English-speaking anxiety. Given the critical role of English-speaking anxiety in language acquisition, it is recommended that teachers consider these variables when guiding students. They should create motivating and supportive learning environments that foster self-expression and establish a positive classroom atmosphere conducive to foreign language learning.

Keywords: English speaking anxiety, personality traits, English speaking self-efficacy perceptions, secondary school students.

Introduction

Learning a foreign language, which is one of the crucial parameters of the modern world, is considered very important for social and economic development as well as the welfare of individuals and society. With the transformations brought about by globalization, learning a foreign language has increasingly gained significance and emerged as a fundamental necessity. English, in particular, has become the most commonly taught language in Turkey and the most widely spoken global language in the world. However, there are some problems in the acquisition of speaking, which is seen as the most important skill in the foreign language education. This situation may be caused by many factors such as individuals' low language proficiency and anxiety about speaking English (El Shazly, 2021).

There are four basic skills in foreign language education: reading, writing, speaking and listening. Today, individuals are more interested in speaking rather than other skills and it is stated that the development of speaking skills shows the success in foreign language learning. For this reason, the development of speaking skills is given more importance in our country and in other countries where English is taught. However, individuals do not reach the desired level of proficiency in productive language skills, especially in speaking skills (Zhang et al., 2020), because there are many cognitive and affective factors that affect language learning such as new linguistic characteristics, a distinct culture, and even thinking styles (Zambak, 2016).

Since speaking skills are emphasized more in foreign language learning, this topic has become increasingly significant, leading to a more detailed investigation of the factors influencing speaking skills (Altın & Saracaloğlu, 2019; Elsharkawy, 2019; Gardner & MacIntyre, 1993;

Özkan, 2019). These studies have explored foreign language learning not only from a cognitive perspective, focusing on aspects like learning style and language proficiency, but also from an affective perspective, addressing factors like motivation and anxiety. As Haidara (2016) points out, psychological factors like self-confidence as well as structural features such as vocabulary and grammar influence speaking skills in foreign language learning. As a matter of fact, Krashen (1981) states that as foreign language learning anxiety increases, verbal performance decreases. Most of the researchers (Aydın, 1999; Elsharkawy, 2019; Gardner & MacIntyre, 1993; Horwitz et al., 1986) emphasize that although individuals have the necessary cognitive competence to speak English, they cannot actively use this competence for speaking and the most important reason for this is anxiety, being one of the affective factors.

Language anxiety represents a specific type of anxiety, characterized by a complex interaction of unique perceptions, emotions, and behaviors related to language learning, arising from the unique characteristics of the language acquisition process (Horwitz et al., 1986). Furthermore, Gardner and MacIntyre (1993) define foreign language anxiety as the feeling of discomfort, nervousness, and anxiety experienced in learning or using a second/foreign language. Foreign language speaking anxiety and language anxiety can be considered together because speaking anxiety is defined as the cause of language anxiety and both affect individuals' foreign language learning (Özkan, 2019). Horwitz (2001) emphasizes that almost half of foreign language learners experience language anxiety and similarly, Campbell and Ortiz (1991) emphasize that students are very negatively affected by language anxiety. Therefore, it is common to have such negative feelings in the context of foreign language learning, particularly concerning speaking skills.

Literature review reveals the presence of studies addressing foreign language speaking anxiety. Çağatay (2015) explains that speaking anxiety is an obstacle in speaking as a productive language skill and causes failure and lack of motivation in this process. Gardner and MacIntyre (1993) state that speaking causes more anxiety than other skills. Young (1990) states that expecting students to demonstrate speaking and writing skills before their reading and listening skills are well developed can lead to anxiety and failure. Similarly, Park (2009) states that speaking anxiety hinders the development of verbal skills in adult learners. In addition, Febrianti (2011) emphasizes that speaking is among the most essential skills in foreign language acquisition; however, it is the area where students tend to achieve the lowest performance and very few reach proficiency close to that of a native speaker. As can be seen from these studies, English speaking anxiety is recognized as a primary factor contributing to the failure in foreign language learning process, fostering a negative correlation between language learning and anxiety (Horwitz, 2001). In this case, it is seen that there is a need for studies to examine students' English speaking anxiety, which has an important effect on the process of learning English, and the variables that may be related to this anxiety.

English speaking proficiency is seen as an important skill in foreign language learning and much effort is expended by both teachers and students for its development (Zambak, 2016). Developing speaking proficiency in foreign language learning process provides many benefits to the individual both psychologically and academically. However, despite all efforts, speaking in a foreign language often causes anxiety and especially the activities that require verbal communication skills in the classroom are seen as a cause of anxiety for learners (Gardner & MacIntyre, 1993; Horwitz et al., 1986). Many studies in the literature (Aydın, 1999; Bozok, 2018; Elsharkawy, 2019; Horwitz et al. 1986; Özkan, 2019; Young, 1990; Zambak, 2016) indicate that foreign language speaking proficiency is an important factor in success in foreign language learning and these studies indicate a negative relationship between foreign language speaking anxiety and success in verbal communication skills. Therefore, it is thought that English speaking self-efficacy is effective on English speaking anxiety.

Studies in the literature (Asmalı, 2017; Doğan, 2008; Hamzadayı & Büyükikiz, 2015) indicate that personality, defined as the characteristic features that set individuals apart from others (Cüceloğlu, 1996; Horzum et al., 2017), has an important effect on foreign language learning. Because personality is a concept that includes both mental and emotional characteristics of the individual. The effect of the personality traits of the individual shows itself in educational environments and especially in foreign language learning (Ay, 2014). Therefore, it is thought that learners' personality traits have a predictive power on the speaking anxiety they experience while learning a foreign language.

A review of the literature reveals that scholars have conducted studies to investigate the causes of English-speaking anxiety (Aydın, 1999; Bozok, 2018; Duman et al., 2017; Elsharkawy, 2019; Tum & Kunt, 2013; Zambak, 2016) because foreign language learning requires many interactions such as personality traits as well as individuals' proficiency. Most of the studies (Altın & Saracaloğlu, 2019; Balemir, 2009; Hamzadayı et al., 2018; Karagöl & Başbay,

2018; Kozikoğlu & Kanat, 2018; Özkan, 2019; Tuncer & Doğan, 2015) have studied foreign language anxiety in relation to variables such as gender, age or psychological factors. However, there is a lack of research exploring the impact of English speaking self-efficacy and personality traits of secondary school students on English speaking anxiety. Vural (2017) examined the relationship between prospective English language teachers' personality traits, their English speaking anxiety and English speaking self-efficacy. It is thought that English speaking proficiency and personality traits are very important in this context. Because the individual may be affected by unfavorable environmental conditions, negative language learning experiences, may not have other competencies that require speaking skills, or may not be exposed to the language learned, which is a very important factor in language learning (Tanrıöver, 2012; Zambak, 2016). In this case, it is thought that there is a need for studies to determine to what extent English speaking self-efficacy perception and personality traits, which are seen as variables that may be effective on English speaking anxiety, predict English speaking anxiety of secondary school students.

Purpose of the Study

The purpose of this study is to investigate the relationship between English speaking anxiety, English speaking self-efficacy, and personality traits among secondary school students in the central districts of Van province. To achieve this objective, the following research questions were addressed:

1. Is there a significant relationship between English speaking anxiety, English speaking self-efficacy and personality traits of secondary school students?
2. Do secondary school students' English speaking self-efficacy and personality traits significantly predict their English speaking anxiety?

English speaking proficiency includes psychological readiness as well as structural features such as vocabulary, grammar, and pronunciation (Öztürk & Gürbüz, 2014; Yule, 2016). Someone who has proficiency in speaking English is expected to use the language accurately and fluently, but not having this proficiency at the desired level can cause anxiety and ultimately failure (Horwitz et al., 1986; Krashen, 1981; Şahin et al., 2016). In addition, it is known that personality traits such as self-confidence, sociability, self-confidence, openness to experience play an important role in foreign language learning (Erton, 2010; Hamzadayı & Büyükikiz, 2015). Considering all these, it is seen that English speaking anxiety has very important effects on success in foreign language learning. Therefore, it is thought that addressing variables such as English speaking self-efficacy and personality traits that may be effective on English speaking anxiety in the context of cause and effect may contribute to the literature.

Methods

Research Design

This study was carried out using the correlational survey design. This model investigates the presence and extent of the relationships among two or more variables. (Büyüköztürk et al., 2017). In this study, since the relationship between English speaking anxiety, English speaking self-efficacy and personality traits of secondary school students was examined, it was deemed appropriate to use the correlational survey model.

Population and sample

The study population for this research includes students attending secondary schools in the central districts of Van province during the 2020-2021 academic year. Considering that the language and expressions used in the scale items may be difficult for students to understand, 5th grade students were excluded from participation in the study. Based on the data provided by the Van Provincial Directorate of National Education, the distribution of the 6th, 7th and 8th grade students in secondary schools according to districts is displayed in Table 1.

Table 1.

Number of secondary school students in the study population

Districts	6th Grade	7th Grade	8th Grade	Total
İpekyolu	6234	6441	6721	19396
Tuşba	3353	3413	3313	10079
Edremit	2895	2896	2939	8730
Total	12482	12750	12973	38205

When Table 1 is examined, a total of 38,205 secondary school (6th, 7th and 8th grade) students (19,396 students in İpekyolu district, 10,079 students in Tuşba district and 8,730 students in Edremit district) study in schools within the three central districts of Van province. In this study, since it was difficult to reach the entire study population in terms of time, labor and facilities, it was decided to take sample. In this study, cluster sampling method was used to determine the sample. Cluster sampling is a sampling technique when all clusters in the population have equal chances of being selected individually (Karasar, 2014). In order to better represent the study population, secondary schools in the central districts of Van province were divided into three groups as high, medium and low according to their socio-economic development levels. A certain number of secondary schools were randomly selected from each group. In these schools, a certain number of classes

from each grade level were randomly selected. The sample of the study consisted of 920 students enrolled in these schools and classes. In determining the sample size; in cases where the population is 40,000, a sample size of 655 at the ".01" significance level is regarded as adequate to represent the population. (Çıngı, 1994; as cited in Büyüköztürk et al., 2017). Therefore, it can be deemed that the sample in this study is sufficiently large to represent the target population. The distribution of the secondary school students according to the grade level, socio-economic development level of the school and gender is displayed in Table 2.

Table 2.
Distribution of students in the sample by gender, grade level and socio-economic development level of the school

Descriptive Variables	Category	Number (N)	Percent (%)
Gender	Female	584	63.5
	Male	336	36.5
Grade level	6th Grade	327	35.5
	7th Grade	262	28.5
	8th Grade	331	36.0
Socio-economic development level of the school	Low	307	33.4
	Medium	262	28.5
	High	351	38.2
	Total	**920**	**100**

According to Table 2, 584 (63.5%) of the students were female and 336 (36.5%) were male. 327 (35.5%) of the students were in the 6th grade, 262 (28.5%) in the 7th grade and 331 (36.0%) in the 8th grade. When the schools are analyzed according to socio-economic development level, it is seen that the number of students from each stratum is close to each other. It is seen that 307 (33.4%) students from low socio-economic development level schools, 262 (28.5%) students from medium socio-economic development level schools and 351 (38.2%) students from high socio-economic development level schools were sampled.

Data Collection Tools

Five Factor Personality Scale

The scale developed by the researchers consists of 20 items. The "Big Five" model, which is recognized as an inclusive model of personality traits, was taken as a basis in the development of the scale for determining the personality traits of secondary school students. The Big Five personality traits framework posits that individual differences can be classified into five separate and independent dimensions (Digman, 1990; McCrae & Costa, 2008). A comprehensive assessment model has been developed, which is widely accepted by experts working on personality, including extraversion, agreeableness, conscientiousness, emotional instability (neuroticism) and openness to experience (Goldberg, 1990; McCrae & Costa, 2008).

The pilot study was conducted with 224 secondary school students studying in the central districts of Van province. Five sub-factors were found in the 5-point Likert scale as a result of exploratory factor analysis and these factors were determined as openness to experience (4 items), conscientiousness (4 items), neuroticism/emotional instability (5 items), extraversion (4 items), and agreeableness (3 items). The total variance explained by these five factors was calculated as 66.720%. Cronbach Alpha internal consistency coefficients were analyzed to determine the reliability of the scale. Cronbach Alpha values were calculated as 0.86 for the first factor, 0.85 for the second factor, 0.80 for the third factor, 0.82 for the fourth factor and 0.79 for the fifth factor. In this study, Cronbach Alpha values were calculated as 0.72 for the first factor, 0.81 for the second factor, 0.87 for the third factor, 0.80 for the fourth factor and 0.85 for the fifth factor. These values indicate that the data collected from the scale exhibit reliability.

English Speaking Self-Efficacy Scale

While creating the trial form of the scale developed by the researchers, items were prepared by taking into account the dimensions (competency areas) of grammar, vocabulary, pronunciation/vocalization, listening comprehension, fluency/expression. The relevant literature was reviewed and as many behavioral statements as possible were written by making use of similar studies, scales and questionnaires in Turkey and abroad. Then, the behavior statements were examined in terms of content, simplicity and clarity and necessary corrections were made. The items that needed to be removed were removed and 20 behavioral statements were determined. To assess the content validity, clarity, and relevance of the items, the pilot version was presented to expert opinion from the fields of Educational Sciences, Turkish Education and English Education. The experts were asked to evaluate the behavioral statements in terms of content validity, comprehensibility, language, content and reflection of the specified features. Feedback was received from seven experts and certain suggestions were made accordingly. Based on the experts' feedback, required revisions were made to certain items, and a pilot form comprising 20 items was developed.

The pilot study was carried with 224 secondary school students studying in the central districts of Van province. The exploratory factor analysis of the 20-item 5-point Likert scale revealed that the scale demonstrated a

unidimensional structure. The total variance explained by the single factor was calculated as 51.666%. The reliability of the scale was assessed by analyzing the Cronbach's alpha internal consistency coefficients. Cronbach Alpha internal consistency coefficient was calculated as 0.95 for the total scale which was found as 0.79 in this study. These values indicate that the data collected from the scale exhibit reliability.

English Speaking Anxiety Scale

In this study, the scale developed by Horwitz et al. (1986) was employed to assess students' foreign language speaking anxiety. The scale was adapted into Turkish by Aydın (1999), and Saltan (2003) selected and utilized 18 items from the original 33-item scale. The adapted scale consists of four sub-dimensions, namely "communication anxiety (6 items)", "fear of negative evaluation (7 items)", "test anxiety (2 items)", "English class anxiety (3 items)" and a total of 18 items. The items in the scale are rated on a 5-point Likert scale. In his thesis study, Altın (2018) conducted a validity and reliability study of the 18-item scale with secondary school students. The results of the confirmatory factor analysis indicated that the model should be reduced to a single dimension because the correlation between the dimensions in the model was found to be greater than .90. The Cronbach Alpha internal consistency coefficient of the scale was .98 which was calculated as .95 in this study. These values indicate that the data collected from the scale exhibit reliability.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Van Yüzüncü Yıl University Social and Humanities Sciences Ethics Committee (Date: 16.09.2020, Number: E- 61176)
- Informed consent has been obtained from the participants.

Data Analysis

Pearson Product-Moment Correlation Coefficients were used to analyze the relationship between students' English speaking anxiety, English speaking self-efficacy, and personality traits. Pearson Product Moment Correlation Coefficient is used to determine the degree and direction of the relationship between variables on normally distributed data. These values; "between .00-.29" was interpreted as a low level relationship, "between .30-.69" as a moderate level relationship, "between .70-1.00" as a high level relationship. Additionally, stepwise regression analysis was used to examine the predictive power of students' English speaking self-efficacy and personality traits on their English speaking anxiety.

Before conducting the differential analyses, normality test was performed to determine whether the data displayed normal distribution. In the analyzes performed to determine univariate normality, it was found that skewness and kurtosis values were within ± 1. For normality to be accepted, skewness and kurtosis values are expected to be within ± 1 (Büyüköztürk, 2018). In line with these values, it was decided that the data provided a normal distribution.

Box's M test for the distribution of covariance matrices and Levene's Test for the homogeneity of variances were analyzed. The results demonstrated that the test findings were not statistically significant ($p > .05$), supporting the conclusion that the assumptions of homogeneity of variance-covariance matrices were met (Büyüköztürk, 2018). Mahalanobis distance values were calculated to assess multivariate normality, and outliers were removed from the dataset prior to analysis. The linear relationship between the dependent variables was assessed through scatter plots, and it was determined that the assumption of linearity was satisfied. Furthermore, it was found that there were moderate to strong correlations between the dependent variables, with the highest correlation being .725. Then, it was concluded that both multivariate normality and linearity assumptions were satisfied, and no multicollinearity issues existed among the dependent variables.

Results

Results Concerning the First Sub-Problem

In accordance with the the study's first sub-problem, Pearson Product-Moment Correlation Coefficients were computed to assess the relationships between students' scale scores, and the results are displayed in Table 3.

Table 3.

Pearson product-moment correlation coefficients concerning the study's variables

Scales and sub-dimensions	1	2	3	4	5	6	7
1. Speaking anxiety	1.00	-.468**	-.189**	-.142**	-.074*	.189**	-.148**
2. Speaking self-efficacy		1.00	.334**	.193**	.328**	-.365**	.250**
3.Extraversion			1.00	.483**	.501**	-.524**	.508**
4.Agreeableness				1.00	.638*	-.476**	.725**
5.Conscientiousness					1.00	-.541**	.608**
6.Neuroticism						1.00	-.460**
7. Opennes to experience							1.00

*p < .05 *, p < .01***

According to the data in Table 3, there is a moderate, negative and significant relationship between students' speaking anxiety and speaking self-efficacy (r= -.468; p < .01); and there is a low, negative and significant relationship between students' speaking anxiety and the sub-dimensions of extraversion (r= -.189; p < .01), agreeableness (r= -.142; p < .01), conscientiousness (r= -.074; p < .05), and openness to experience (r=-.148; p < .01), and a low, positive and significant relationship between speaking anxiety and neuroticism (r= .189; p < .01).

There is a moderate, positive and significant relationship between students' English speaking self-efficacy and sub-dimensions of extraversion (r=.334; p <.01) and conscientiousness (r=.328; p < .01) traits; a low, positive and significant relationship between agreeableness (r=. 193; p < .01) and openness to experience (r=.250; p <.01) traits; and a moderate, negative and significant relationship between neuroticism (r=-.365; p < .01) trait.

Results Concerning the Second Sub-Problem

In accordance with the the study's second sub-problem, the results of the stepwise regression analysis are displayed in Table 4.

Table 4.

Stepwise regression analysis results on the prediction of students' English speaking anxiety

Steps	Predictor variables	β	Predictive power (R)	Explained variance (R^2)
1.	Speaking self-efficacy	-.468	.468	.219
2.	Opennes to experience	-.176	.498	.248
3.	Extraversion	-.154	.514	.264
4.	Neuroticism	.073	.518	.268
5.	Agreeableness	-.087	.521	.271

According to the data in Table 4, it can be observed that students' English speaking self-efficacy and the five-factor personality traits of openness to experience, extraversion, neuroticism and agreeableness explain 27.1% of the variance in students' English speaking anxiety. The variance analysis results concerning the stepwise regression analysis are displayed in Table 5.

Table 5.

Variance analysis results on the prediction of students' English speaking anxiety

Model	Sum of Squares	Sd	Mean of Squares	F	p
Regression	128.137	5	25.627	68.042	.000
(Residual)	344.251	914	.377		

According to the data in Table 5, the predictive power obtained in the stepwise regression analysis given in Table 4 is significant ($F_{(5,914)}$=68.042, p < .000). The regression analysis for predicting students' English speaking anxiety was carried out in five stages, and five variables were identified as significant predictors. The analysis results indicated that students' English speaking self-efficacy, which was included in the regression equation as a significant predictor, had the power to explain 21.9% of the variance in English speaking anxiety, openness to experience had the power to explain 2.9% of the variance, extraversion had the power to explain 1.6% of the variance, neuroticism had the power to explain 0.4% of the variance, and agreeableness had the power to explain 0.3% of the variance. However, conscientiousness personality trait did not contribute significantly to the total variance and did not predict students' English speaking anxiety at a significant level.

Discussion

The study found a moderate, negative, and significant correlation between students' English speaking anxiety and speaking self-efficacy. Additionally, a low, negative, and significant correlation was observed between students' English speaking anxiety and the personality traits of extraversion, agreeableness, conscientiousness, and openness to experience. A low, positive, and significant correlation was also found between students' neuroticism personality trait and their English speaking anxiety. A moderate, positive, and significant correlation was identified between students' English speaking self-efficacy and extraversion and conscientiousness personality traits; a low, positive and significant relationship between agreeableness and openness to experience personality traits; and a moderate, negative and significant relationship between neuroticism personality trait. In addition, it concluded that students' English speaking self-efficacy was the most important predictor of students' English speaking anxiety (21.9%), followed by openness to experience (2.9%), extraversion (1.6%), neuroticism (0.4%) and agreeableness (0.3%) personality traits. In this context, it was found that students' English speaking self-efficacy and the five-factor personality traits of openness to experience, extraversion, neuroticism, and agreeableness collectively accounted for 27.1% of the variance in students' English speaking anxiety.

The results of this study are consistent with the results of similar studies in the existing literature. In a study conducted with university students, Vural (2017) discovered a significant, negative relationship between English speaking self-efficacy and English speaking anxiety. Similarly, many studies in the literature (Chen, 2007; Liu,

2006; Marcos-Llinás & Garau, 2009; Özkan, 2019; Woodrow, 2006) have identified a negative relationship between self-efficacy and anxiety in language learning. Unlike those studies' results, Balemir (2009) reported that the proficiency level of students in the foreign language process did not have a significant role in their speaking anxiety. That is to say, proficiency level did not have any facilitating or debilitating impact on students' foreign language speaking anxiety. Conversely, there are also research studies available in the literature (Tahsildar & Kabiri, 2019; Tuncer & Doğan, 2015) indicating that as students' proficiency level increases, their foreign language learning and speaking anxiety increases. Upon reviewing the literature, it is evident that the majority of related studies corroborate the results of this research. According to the this study's results, it can be concluded that there is a negative relationship between English speaking anxiety and English speaking self-efficacy, in other words, as students' English speaking self-efficacy increases, their English speaking anxiety decreases. In addition, it was found that students' English speaking self-efficacy was the most important predictor (21.9%) of students' English speaking anxiety. Similarly, Vural (2017) reported that English speaking self-efficacy was the strongest predictor of English speaking anxiety. Anyadubalu (2010) and Yule (2016) emphasize that foreign language proficiency is an important factor on the performance in lessons. Therefore, it can be argued that eliminating the factors that cause anxiety in students will motivate them to be more successful in English lessons or to increase their speaking self-efficacy. In this case, it can be concluded that students' English speaking self-efficacy has a significant effect on English speaking anxiety, and therefore, improving students' English speaking self-efficacy is an important factor in reducing English speaking anxiety.

Similarly, the results regarding the correlation between English speaking anxiety and personality traits support the results of the studies in the literature. In Vural's (2017) study, negative and significant relationships were found between English speaking anxiety and the personality traits of extraversion, openness to experience, conscientiousness, and agreeableness, respectively; while a low level, positive and significant relationship was found between neuroticism. Öztürk and Gürbüz (2014) stated that personality traits are an important factor on foreign language anxiety and motivation. Similarly, it is stated that individuals with positive personality traits (extraversion, openness to experience, conscientiousness, and agreeableness) demonstrate reduced anxiety, increased energy, and a more positive attitude toward language learning tasks, which enhances their participation in classroom activities (Kiany, 1998). However, Köksal et al. (2014) examined the relationship between foreign language anxiety and personality traits and found that there is no significant correlation between learners' personality traits and their levels of foreign language learning anxiety. Drawing on the results of this study and existing literature, it can be concluded that the more extroverted, open to new and different developments, responsible and agreeable students are, the less worried they are about speaking English; the more unstable their emotional states are, the more anxious they are about speaking English. It is stated that individuals with extroverted, non-neurotic and agreeable personality traits are more successful in foreign language learning process (Ehrman, 1990). Thus, it can be asserted that personality traits play a significant role in English speaking anxiety and they should be acknowledged as a critical factor in the process of foreign language learning.

In addition, it was determined that openness to experience (2.9%) personality trait was the strongest predictor of English speaking anxiety after English speaking self-efficacy, followed by extraversion (1.6%), neuroticism (0.4%) and agreeableness (0.3%) personality traits. Similarly, Vural (2017) found that extraversion and openness to experience significantly predicted English speaking anxiety negatively, while neuroticism and agreeableness significantly predicted it positively. Piechurska-Kuciel (2018) found that there were significant relationships between openness to experience personality trait and verbal skills in a foreign language and that this personality trait was the strongest predictor of anxiety in communication skills. Similarly, Er et al. (2016) found that extraversion, openness to experience, conscientiousness, and agreeableness personality traits significantly predicted anxiety in four basic language skills. Therefore, it can be said that extraversion, openness to experience, neuroticism and agreeableness are important variables in predicting English speaking anxiety. In addition, it can be concluded that learners with positive personality traits (extraversion, openness to experience, conscientiousness and agreeableness) are more sociable, harmonious and talkative in the society or in the circle of friends, so they are less anxious about speaking English and volunteer to participate in activities and activities in the classroom.

The study revealed a moderate, positive, and significant correlation between students' English-speaking self-efficacy and the personality traits of extraversion and conscientiousness; a low, positive and significant relationship between agreeableness and openness to experience personality traits; and a moderate, negative and significant relationship between neuroticism

personality trait. Vural (2017) found positive and significant relationships between English speaking self-efficacy and openness to experience, extraversion, conscientiousness, and agreeableness personality traits respectively; a low level, negative and significant relationship was found between neuroticism. Alishah (2015) found positive and significant relationships between communicative skills in English and extraversion, and negative and significant relationships between introversion personality traits. Similarly, Apple (2011) reported that there were positive and significant relationships between English speaking proficiency and openness to experience, extraversion, conscientiousness, and agreeableness personality traits, while a negative and significant relationship was found between neuroticism. Drawing on the results of this study and existing literature, it can be concluded that except neuroticism, the other positive personality traits have positive relationships with English speaking self-efficacy, and therefore these personality traits positively affect English speaking self-efficacy. MacIntyre and Charos (1996) state that extraversion and openness to experience personality traits are related to self-confidence and motivation and that these individuals have higher self-efficacy in speaking in a foreign language. On the other hand, Vural (2017) emphasizes that self-disciplined and well-organized students are more competent in speaking English than negligent and disorganized ones. Niazi (2017) stated that people with agreeableness personality traits are sensitive to sympathize and cooperate with other people. In this case, it can be argued that learners with positive personality traits (openness to experience, extraversion, conscientiousness, and agreeableness) think that they are better at activities that require verbal skills in a foreign language, and they consider themselves more competent in English speaking skills.

Conclusion and Recommendations

This study concluded that students' personality traits, English-speaking anxiety, and perceptions of speaking self-efficacy were related to each other. This study is expected to contribute to the relevant literature by identifying potential predictor variables influencing English-speaking anxiety, which is seen as an important problem in English language teaching, and examining the variables related to English speaking anxiety. In this context, it may be proposed that students' personality traits should be taken into consideration in the English language teaching process. In this way, teachers can obtain more appropriate learning environment and experiences for teaching English in the classroom, students can participate more in the lesson, and this can lead to a sense of self-confidence in them. In addition, this study focused on the variables that predict English speaking anxiety by looking at the relationship with various variables (English speaking self-efficacy perception, personality traits). In future studies, different variables that may be related to English speaking anxiety (characteristics of the learning environment, teacher behaviors, teaching strategies, attitudes, etc.) can be included to examine their effect or predictive power on English speaking anxiety.

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The Effect of School Culture on School Engagement: The Mediating Role of Social and Emotional Learning

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ABSTRACT

This study investigated how social and emotional learning mediates the relationship between adolescents' perceptions of school culture and their levels of school engagement. A total of 365 high school adolescents (52.9% female, 47.1% male) participated, with data collected using the School Engagement Scale, School Culture Scale, Adolescents' Social and Emotional Learning Scale, and a Demographic Information Form. The Pearson product-moment correlation analysis results show that there are statistically significant positive relationships between school culture, school commitment, and social and emotional learning variables. It was discovered that the school culture significantly predicted school engagement in adolescents. Findings indicated a significant effect of school culture on social and emotional learning, and this, in turn, significantly affected students' engagement with school. The study concluded that the relationship between school culture and school engagement in adolescents was partially mediated by social and emotional learning, with its indirect impact proving significant.

Keywords: School culture, school engagement, social and emotional learning, mediation

Introduction

The substantial time children and adolescents spend at school underscores the critical role schools play in shaping their lives. Establishing environments where students feel peaceful, happy, and safe is a crucial factor in enhancing their attachment to school (Sarı, 2013). School environments where students do not feel a sense of belonging, where they perceive the knowledge taught as meaningless, and where they cannot form an emotional connection with the school or its staff negatively impact their educational activities (Kılıç, 2022). Thus, students may disengage from their educational experiences. Therefore, it is essential for students to develop attachment to schools, given the significant role schools play in their lives during childhood and adolescence.

Engagement consists of various interactions that are active, goal-oriented, flexible, constructive, consistent, and focused between individuals and their social and physical environments (Furrer & Skinner, 2003). Active involvement in school activities, a strong sense of belonging, and appreciation for the school's goals are central to the concept of school engagement (Finn, 1989). Mosher and McGowan (1985) define the school engagement as the attitudes and behaviors that lead to students' involvement in school programs. Connell and Wellborn (1991) emphasize that school engagement develops when the group environment satisfies students' three essential psychological needs: autonomy, competence, and relatedness.Newmann et al. (1992) also describe the school engagement as the psychological investment and effort students make to learn, understand, or master the knowledge, skills, and crafts encouraged by academic activities. Osterman (2000) views the school engagement as a sense of belonging to a group, while Maddox and Prinz (2003) define it as the relationships students establish with their schools and various aspects of their academic lives. Accordingly, the school engagement can be described as the quality of students' relationships with their schooling efforts, other individuals, school activities, goals, values, and the school environment itself (Skinner et al., 2009). These definitions indicate that school engagement is a vital component influencing students' academic, social, and emotional growth.

Low levels of school engagement during adolescence represent a significant issue, as they are associated with problematic behaviors such as increased school dropout rates, substance use, early pregnancy, and criminal activity (Caraway et al., 2003). Empirical studies show that the school engagement is negatively correlated with health-risk behaviors (Dolzan et al., 2015; Şimşek & Çöplü, 2018), tendencies towards violence (İkiz & Sağlam, 2017), school dropout (Archambault et al., 2009; Arslan, 2021), the risk of substance abuse and involvement in crime (Li et al., 2011; Wang & Fredricks, 2014), school burnout (Özdemir, 2015), and internet addiction (Taş, 2017). The study highlights that school engagement functions as a key factor in preventing and mitigating adolescents' inclination toward negative behaviors.

Strengthening school engagement is seen as a key approach to resolving issues related to low academic success and school attrition (Finn, 1993; Fredricks et al., 2004). Students who attend school regularly, maintain learning consistency, build positive relationships with those around them, actively participate in school activities, and possess a positive sense of belonging demonstrate a high level of school engagement (Christenson et al., 2001). Students with high levels of school engagement continuously engage in learning activities with positive emotions, choose tasks that match their competency levels, exert significant effort and attention in learning activities, and exhibit excitement, optimism, curiosity, and interest in various activities (Skinner & Belmont, 1993). School engagement is an important prerequisite for students' learning processes and overall school experiences.

School culture is a significant factor that can impact students' levels of school engagement. Schools are organizations that produce values, operate based on those values, and strive to realize significant values. Like other organizations, each school has a unique culture. The school culture significantly influences schools' growth, their ability to adapt to changes, and their long-term sustainability (Recepoğlu, 2014; Şişman, 2004). It is defined in different ways in the literature. School culture is defined as the values, belief systems, and traditions that emerge over time within the historical process of schools (Deal & Peterson, 1990). Stolp and Smith (1995) describe the school culture as a set of historical patterns of meaning, including norms, values, belief systems, traditions, and myths shared by school administrators, teachers, students, and other staff members. When the definitions are examined, it is seen that school culture contains many elements. These elements are represented by a common sense of purpose, vision, shared norms, values, beliefs, assumptions, and practices such as rituals, traditions, ceremonies, as well as historical accounts, stories, architecture, artifacts, and symbols (Peterson & Deal, 2002). The culture of a school impacts all of its processes and practices, and school-related issues are not independent of the school's culture (Şişman, 2020). School culture is associated with positive outcomes. A positive school culture is defined by motivated students, strong academic achievement, a collaborative teaching environment, and teachers' positive feelings about their professional contributions (Stolp & Smith, 1995). Furthermore, positive cultures have various functions such as guiding the behavior of those involved with the school, fostering commitment to the school's values, enhancing the motivation of students and teachers, and contributing to the school's effectiveness and creativity (Peterson & Deal, 2002). Given the effects of school culture, it can be concluded that the characteristics of a school's culture will influence students' development of attachment to their schools.

A key variable associated with school engagement is social and emotional learning, which involves developing the skills, attitudes, and values needed for achieving social and emotional competence (CASEL, 2003; Elias et al., 1997). Social and emotional learning, as defined by CASEL (2020), is a vital part of education and human development, involving the acquisition and application of knowledge, skills, and attitudes to develop healthy identities, manage emotions, achieve goals, demonstrate empathy, build relationships, and make responsible decisions. Schools play a crucial part in nurturing students' social and emotional skills, contributing to their overall healthy development (Durlak et al., 2011). Through social and emotional education, the goal is for students to become citizens with positive values, establish effective relationships with others, and learn constructive behaviors (Elias et al., 1997). Supporting social and emotional learning in schools is evidently important for students to gain diverse competencies necessary for their growth.

Social and emotional learning practices create opportunities for students to develop critical life skills necessary for their growth (Greenberg et al., 2017). These programs help students develop their skills and cognition to successfully navigate the challenges they face in life. Additionally, they help transform and improve school climate by creating environments where students will want to belong (Yeager, 2017). Efforts to support students' social and emotional learning can foster their attachment to their schools.

In research conducted in Turkey, social and emotional learning has been examined in relation to variables such as self-esteem (Merter, 2013), life satisfaction, hope (Kabakçı & Totan, 2013), emotional intelligence (İşeri, 2016), family and peer support, hope levels (Candan & Yalçın, 2018), as well as life satisfaction and psychological resilience (Yıldız & Kahraman, 2021).

Social and emotional learning programs create safe, caring, and well-managed learning environments that enhance students' school engagement. This is associated with fewer risk behaviors and higher academic performance (CASEL, 2003). Social and emotional learning plays a crucial role in enhancing students' engagement within the school environment. Research in the literature also shows that social and emotional learning competencies significantly predict school engagement. One study found that students' self-esteem positively predicted school engagement over time (Karababa, 2020). Another study found that self-efficacy scores significantly predicted school engagement (Caraway et al., 2003). A study on social competence found that social competence assessed at Time 1 significantly predicted students' school engagement assessed at Times 1 and 2 (Simons-Morton & Crump, 2003). These results underscore the significance of social and emotional learning as a key factor in boosting school engagement.

The absence of research involving these three variables suggests that this study will provide valuable insights to the related body of knowledge. Based on these reasons, the aim of the current research is to investigate the effect of school culture on the level of school attachment in adolescents and the mediating role of social and emotional learning in this relationship.

Methods

Research model

This study employed a correlational survey model. Correlational survey models aim to identify the relationships between multiple variables and determine the degree of change (Karasar, 2012). In the research model of the current study, school culture is the independent variable (X), school engagement is the dependent variable (Y), and social and emotional learning (M) is the mediating variable.

Participants

The study's participants consisted of 365 individuals, 193 (52.90%) of whom were female and 172 (47.10%) male. The students' ages ranged from 14 to 18, with an average age of 16.11. Specifically, 48 participants (13.20%) were 14 years old, 72 (19.70%) were 15 years old, 90 (24.70%) were 16 years old, 102 (27.90%) were 17 years old, and 53 (14.50%) were 18 years old. 88 students (24.10%) were in 9th grade, 96 (26.30%) in 10th grade, 82 (22.50%) in 11th grade, and 99 (27.10%) in 12th grade.

Data Collection Tool

School Engagement Scale (SES)

Fredricks et al. (2005) created the SES to evaluate the extent of children's engagement within the school environment. The scale consists of three dimensions: behavioral, emotional, and cognitive, with 19 items in total. It is designed in a 5-point likert type and contains 3 reverse-coded items. High scores on the scale indicate high levels of school engagement, while low scores suggest low engagement. The researchers reported Cronbach's Alpha coefficients of .72 for the behavioral dimension, .83 for the emotional dimension, and .77 and .86, respectively, in a subsequent study, with .82 for the cognitive dimension. The scale was adapted into Turkish culture by Çengel et al. (2017), with data collected from 515 middle school students for validity and reliability analyses. Exploratory factor analysis revealed a three-factor structure, supported by sufficient sampling adequacy and significant statistical outcomes, indicating the model's suitability. This structure was further validated through confirmatory factor analysis, which demonstrated a strong alignment between the proposed framework and the data. Cronbach's Alpha reliability coefficients were calculated as .68 for the behavioral dimension, .80 for the emotional dimension, .80 for the cognitive dimension, and .89 for the entire scale. McDonald's Omega reliability coefficients ranged from .74 to .85. Test-retest reliability ranged from .70 to .79. The Cronbach's Alpha for the total SES score was calculated as .83 in this study, indicating high reliability. A Cronbach's Alpha value of .83 was calculated for the total SES score, reflecting its reliability in this study.

School Culture Scale (SCS)

The SCS was developed by Higgins-D'Alessandro and Sadh (1998). The scale comprises 25 items rated on a 5-point Likert scale and is divided into four subdimensions: normative expectations, student-teacher/school relationships, student relationships, and educational opportunities. A principal component factor analysis with orthogonal rotation revealed that the scale has four factors, explaining 51.50% of the variance. The internal consistency analysis for the overall scale yielded a reliability coefficient of .85, with subscale reliability coefficients of .80 for normative expectations, .82 for student-teacher/school relationships, .77 for student relationships, and .78 for

educational opportunities. The scale was adapted into Turkish by Yılmaz (2019), reporting a KMO sampling adequacy of .89 and Bartlett's test result of $\chi 2$= 3078.20. Confirmatory factor analysis indicated acceptable model fit. Cronbach's Alpha coefficients were .89 for the overall scale, .69 for student relationships, .77 for student-teacher/school relationships, .85 for educational opportunities, and .83 for behavioral expectations. Item-test correlations ranged from .37 to .59. The reliability of the total SCS score in this research was reflected by a Cronbach's Alpha coefficient of .91.

Social and Emotional Learning Scale for Adolescents (SELS-A)

The SELS-A was developed by Totan (2018) for adolescents. The scale focuses on five key areas: self-awareness, social awareness, self-management, responsible decision-making, and relationship skills. The long form of the scale was used in this research. All items are positively phrased, and no reverse-coded items are present. Exploratory factor analysis indicated that the five factors had eigenvalues ranging from 1.25 to 4.79, explaining 48% of the total variance. The KMO sampling adequacy was .773, and Bartlett's test yielded a chi-square result of 1814.18 (df =253, p= .000). Confirmatory factor analysis showed that all items loaded significantly on their respective factors and that the model fit was adequate. Cronbach's Alpha values were .92 for the entire scale and .70–.83 for the subdimensions, indicating good reliability. The McDonald Omega coefficient was .94 for the total scale. Test-retest reliability was found to be .82, indicating statistically significant results. In this study, the Cronbach's Alpha reliability coefficient for the total SELS-A score was .86.

The Personal Information Form

This study utilized the researcher-designed Personal Information Form to gather participant demographic data, including their gender, age, school grade, type of school, location of residence, family income, and parents' education levels.

The ethical process in the study was as follows:

- Ethical approval for the study was granted by the Aydın Adnan Menderes University Educational Research Ethics Committee (Date: 27.10.2021, Number: 2018-24).
- Informed consent has been obtained from the participants.

Data Analysis

The statistical analysis for the study was conducted through the SPSS 22.0 software. The assessment of normality for the variables was conducted by analyzing their skewness and kurtosis coefficients. The values of skewness and kurtosis were found to be within the acceptable range of ±1.5. The relationships between variables were examined using Pearson's product-moment correlation, resulting in the identification of significant positive correlations. Following the correlation analyses, Hayes' (2022) PROCESS procedure was used to test the mediation effects.

Results

This study initially explored the relationships between school culture, school engagement, and social and emotional learning among adolescents using Pearson product-moment correlation coefficients. For multivariate statistics to be applied, the assumption of normality must be met. The skewness and kurtosis values calculated for school engagement and its subdimensions were found to range from -.441 to 1.091 for skewness and from -.444 to 1.883 for kurtosis. The skewness values for school culture subdimensions varied from -.526 to .380, with kurtosis values spanning -.444 to 1.883. In contrast, social and emotional learning and its subdimensions reported skewness between -.950 and -.542, and kurtosis values between -2.86 and .837. As a result, it was concluded that the research variables followed a normal distribution. Subsequently, bivariate relationships between the research variables were investigated using Pearson product-moment correlation analysis. The results obtained are presented in Table 1.

The Pearson product-moment correlation analysis revealed statistically significant relationships between school engagement and its subdimensions, ranging from. 74 to. 83 ($p \leq .001$); between school culture and its subdimensions, ranging from .69 to .85 ($p \leq .001$); and between social and emotional learning and its subdimensions, ranging from .74 to .87 ($p \leq .001$). When examining the relationships between the independent, mediator, and dependent variables, significant positive correlations were found between school engagement and school culture (.48, $p \leq .001$), school engagement and social and emotional learning (.57, $p \leq .001$), and school culture and social and emotional learning (.30, $p \leq .001$). Furthermore, the absence of bivariate correlations exceeding. 90 indicated that there was no multicollinearity in the research data. The analysis then proceeded to examine the mediation effect.

Table 1.

Bivariate Relationships Between School Culture, School Engagement, and Social and Emotional Learning

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
Behavioral engagemenet [1]														
Emotional engagement [2]	.40**													
Cognitive engagement [3]	.59**	.31**												
School engagement [4]	.79**	.74**	.83**											
Student relationships [5]	.31**	.38**	.24**	.39**										
Student-teacher/school relationships [6]	.33**	.35**	.38**	.45**	.44**									
Normative expectations [7]	.17**	.18**	.12**	.19**	.45**	.35**								
Educational opportunities [8]	.33**	.37**	.35**	.44**	.47**	.61**	.39**							
School culture [9]	.36**	.40**	.36**	.48**	.69**	.79**	.72**	.85**						
Self-awareness [10]	.35**	.24**	.39**	.43**	.13*	.22**	.05	.21**	.20**					
Social awareness [11]	.39**	.29**	.47**	.49**	.21**	.24**	.07	.25**	.25**	.65**				
Self-managment [12]	.44**	.29**	.49**	.52**	.19**	.27**	.15**	.23**	.27**	.52**	.44**			
Relationship skills [13]	.31**	.28**	.35**	.40**	.27**	.28**	.15**	.22**	.28**	.48**	.49**	.45**		
Responsible decision-making [14]	.40**	.30**	.51**	.52**	.16**	.24**	.06	.22**	.22**	.70**	.66**	.61**	.58**	
Social and emotional learning [15]	.46**	.34**	.54**	.57**	.23**	.31**	.12*	.28**	.30**	.85**	.80**	.74**	.76**	.87**

** p ≤ ,05, ** p ≤ ,001*

Table 2.

The Model on the Effect of School Culture on School Engagement

Variable	b	s.e.	t	*p*	LLCI	ULCI
constant	40.78	.10	19.45	.000**	36.63	44.87
School culture	.31	.03	10.34	.000**	.25	.38

** p ≤ ,05, ** p ≤ ,001*

As shown in Table 2, the effect of school culture on school engagement is statistically significant (c= .48, 95% CI [36.63-44.87], t= 19.45, $p \leq .001$). The increase in school culture explains a 23% increase in school engagement ($R^2 = .23$). According to the obtained results, the direct effect of school culture on school engagement is statistically significant. Following the fulfillment of the initial mediation test condition, the analysis focused on the role of social and emotional learning as a mediator in the relationship between school culture and school engagement. The results are detailed in the table below.

Table 3 shows that, based on the analysis, school culture is a statistically significant predictor of school engagement among adolescents, alongside social and emotional learning (c' = .33, 95% CI [2.82-15.89], t = 8.07, $p \leq .001$). Additionally, the effect of social and emotional learning on school engagement is also statistically significant (b = .47, 95% CI [.36-.51], t = 11.25, $p \leq .001$). However, school culture and social and emotional learning explain a 43% increase in school engagement ($R^2 = .43$). It was also found that the effect of school culture on social and emotional learning is statistically significant (a= .30, 95% CI [67.05-76.65], t= 29.44, p ≤ .001), with school culture explaining 9% of the variance in social and emotional learning ($R^2 = .09$). The research model indicates that all paths are statistically significant. Therefore, the examination of indirect effects was conducted to determine the presence of a mediation effect.

Table 3.

Model on the Effect of Social and Emotional Learning and School Culture on School Engagement

Variable	*b*	s.e.	*t*	*p*	LLCI	ULCI
constant	9.36	.32	2.82	.005*	2.82	15.89
School culture	.22	.03	8.01	.000**	.16	.27
Social and emotional learning	.44	.04	11.25	.000**	.36	.51

* $p \leq .05$, ** $p \leq .001$, b= standardized beta coefficient, s.e.= standard error, LLCI=Lower Limit Confidence Interval, ULCI= Upper Limit Confidence Interval

Table 4.

Direct and Indirect Effects of Social and Emotional Learning on the Relationship Between School Culture and School Engagement in Adolescents

	Effect	Bootsrap s.e.	%95 Confidence interval	
			Lower bound	Upper bound
Direct effect	.22	.03	.17	.27
Indirect effect	.09	.03	.06	.13

** p≤ .05, ** p ≤ .001, b= standardized beta coefficient, s.e.= standard error, LLCI=Lower Limit Confidence Interval, ULCI= Upper Limit Confidence Interval*

The analysis, conducted with the Bootstrap method using 5,000 samples, revealed that the 95% confidence interval for the indirect effect of social and emotional learning on the relationship between school culture and school engagement excludes 0, as shown in Table 4, confirming its significance.

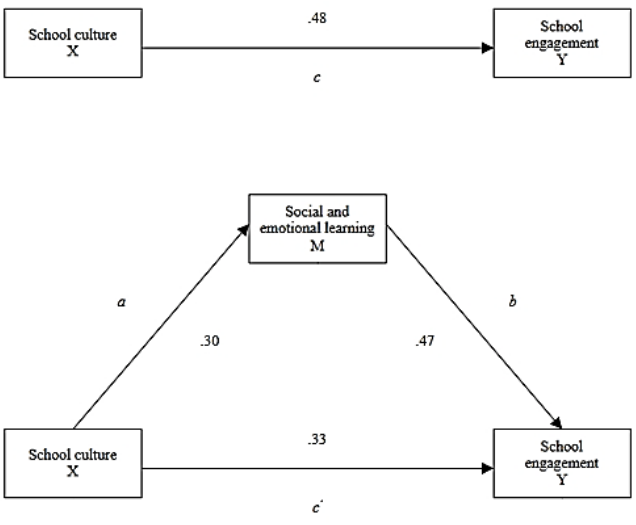

Figure 1.

Social and emotional learning mediates the relationship between school culture and school engagement in the conceptual model

Figure 1 presents the model of the mediation effect. According to the analysis results, the coefficient between school culture and school engagement was determined to be .48. When the social and emotional learning variable was added as a mediator to the model, the coefficient decreased to .33.

Although the coefficient between school culture and school engagement decreased with the inclusion of social and emotional learning in the model, its statistical significance was maintained. However, considering the adequacy of the indirect effect analysis, it was determined that social and emotional learning exhibits a partial mediating effect on the relationship between school culture and school engagement.

Discussion

The study identified a moderate, positive, and significant relationship between school culture and school engagement, emphasizing the role of school culture in shaping students' thoughts and behaviors. The role of school culture is critical in shaping students' thoughts and behaviors within their educational setting (Barth, 2002). Considering the behavioral and cognitive effects of school culture on students, it can be concluded that this variable is related to school engagement. Ceylan and Özgenel (2022) found a moderate positive significant relationship between school culture and students' perceived overall school engagement and its three dimensions, with middle school students. A negative, low-level significant relationship was observed between students following strict rules and their overall school engagement and its subdimensions. Research by Koçak and Ay (2020) revealed a moderately positive significant association between democratic school culture perceptions and school engagement among high school students, echoed by Lagrimas and Buenaventura (2023) who reported a positive significant relationship between school culture perceptions and engagement. Research also shows positive relationships between variables similar to school culture and school engagement. Positive significant relationships have been found between school life quality (Kalaycı & Özdemir, 2013; Dönmez, 2018), school effectiveness (Ergüç-Şahan & Özgenel, 2021), school climate (Fullarton, 2002; Yavrutürk et al., 2020), and school engagement. The findings of the current research, along with similar studies, demonstrate a positive relationship between school culture and school engagement.

The study's analysis demonstrated a moderate positive and significant relationship between school engagement and social and emotional learning variables. This finding is consistent with similar research in the literatureA study by Ross and Tolan (2018) revealed a significant positive connection between social and emotional learning and school engagement. Another study found moderate statistically significant relationships between high school students' levels of social and emotional learning and their engagement (Okur et al., 2022). The findings of Mantz et al. (2018) revealed strong positive relationships between social-emotional competencies and all aspects of school

engagement, including cognitive, behavioral, and emotional. Yang et al. (2018) also confirmed significant positive relationships between social and emotional learning dimensions and school engagement in students from various educational backgrounds. These results support the findings of the current research, which shows a positive relationship between students' social and emotional learning levels and school engagement.

Social and emotional learning programs aim to teach students specific skills and create a classroom and school culture that fosters their development (Greenberg et al., 2017). Moreover, a positive school culture are fundamental components of high-quality social and emotional learning programs (Weissberg et al., 2015). It seems that school culture and social emotional learning programs are related The analysis found out a positive moderate significant relationship between school culture and social and emotional learning variables. No research has been found in the literature that addresses two variables. Findings from Yang et al. (2020) and Tüten (2023) show that school climate is positively linked to social and emotional learning competencies, with the latter study reporting a moderate positive relationship. Adding to the existing literature, the current research indicates that perceptions of school culture are closely linked to social and emotional learning.

The significant predictive role of school culture on school engagement found in this study is supported by existing research. Peterson and Deal (2002) note that school culture permeates the entire school environment, shaping students' thinking, feelings, and actions. Brady (2005) found that school culture has a significant impact on students' perceptions of school engagement. In a study examining various dimensions of school culture, Ceylan and Özgenel (2022) found that sub-dimensions of school culture significantly predicted students' overall school engagement. According to Koçak and Ay (2020), high school students' perceptions of democratic school culture significantly and positively predict school engagement. Gauley (2017) found that students' perceptions of school climate predict school engagement. Other studies have also shown that a safe, supportive, and success-oriented school climate significantly predicts high school students' school engagement (Bilgin & Taş, 2018; İhtiyaroğlu, 2014). Ergüç-Şahan and Özgenel (2021) found that the dimensions of students' perceptions of school effectiveness significantly predict their school engagement, noting that higher levels of school effectiveness lead to higher levels of student engagement. To summarize, students who perceive their schools as supportive, safe, and effective have higher levels of engagement. The findings from this research, along with similar studies, suggest that as students hold more positive perceptions of school culture, their level of school engagement also increases.

This research identified a significant relationship between social and emotional learning and school engagement. Consistent with this, Yang (2015) defined social and emotional learning as comprising teacher-student relationships, peer interactions, and teachers' application of social-emotional teaching methods, demonstrating its predictive role in school engagement. Soltys (2021) also explored the relationship between social and emotional competence and school engagement finding that students' perceptions of social and emotional competence significantly predict their school engagement. Social and emotional competencies were identified by Santos et al. (2023) as critical predictors of student engagement, based on their multi-level modeling findings. Karamanlı-Gül (2019) found that middle school students' social-emotional learning skills significantly predicted their levels of school engagement. These studies support the findings of the current research indicating that social and emotional learning levels, competencies, and skills affect students' school engagement.

The analysis revealed that social and emotional learning significantly mediates the relationship between school culture and school engagement among high school students, with a partial mediating effect confirmed. A literature review found no prior studies examining this indirect relationship. Lagrimas and Buenaventura (2023) found that a constructivist learning environment partially mediates the relationship between school culture and student engagement in a study involving variables with similar characteristics. The research concludes that school culture enhances social and emotional learning, which subsequently boosts school engagement, with social and emotional learning partially mediating this relationship.

Conclusion and Recommendations

Based on the research findings, it is recommended that school counselors, school administrators, teachers, and parents implement interventions to strengthen the school culture. These kinds of efforts could indirectly enhance students' school engagement. Moreover, school counselors can implement psychoeducational programs based on social and emotional learning to increase students' school engagement. School counselors can conduct school-wide initiatives to create a school culture that positively impacts students' social and emotional learning. These efforts could lead to an increase in students' levels of school

engagement. This study focused on high school students; future research could explore similar variables among middle school students in adolescence. Additionally, new research models could investigate the mediating effects of variables other than social and emotional learning.

Ethics Committee Approval: The study received ethical clearance from the Aydın Adnan Menderes University Educational Research Ethics Committee (Date: 27.10.2021, Number: 2018-24).
Informed Consent: Written informed consent was obtained from the parents of all students participating in this study.
Peer-review: External peer review was conducted for this study.
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***This article is derived from a PhD thesis entitled The Effect of Using Gamification Elements in Online Learning Environments on Students' Academic Achievement, Cognitive Load Levels, Online Learning Attitudes and Motivations*

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An Adaptable Gamification Design in Online Education Based on the D6 Gamification Model

ABSTRACT

The aim of this study is to present an adaptive gamification design in online education using the D6 gamification model and to guide researchers and gamification designers in the decision mechanisms that can be used in the gamification process of online systems. The study utilized a design-based research approach by using two iterative cycles during the development of the system. The initial gamification design was developed with the help of existing literature, and then this design was evaluated by a team of 14 people consisting of two software engineers, four educational sciences specialists, one graphic designer, one front end developer, two gamification specialists and four educational technologists selected by purposive sampling method. The design was also applied to a group of 14 female and 20 male students using the system. These students interacted with the system for two weeks and provided feedback in two one-week cycles. At the end of the two-week period, feedback from both experts and students showed that the usability of gamification can be maximized by improving and diversifying the content, increasing interaction, using reward mechanisms correctly, adapting the content for different age groups, including elements such as excitement and progression, encouraging participation with bonus points, balancing points with badges, ranking levels, using sound and time correctly, and designing a user-friendly interface.

Keywords: Gamification, online Learning, design-based research, web based gamification system

Introduction

Gamification involves integrating game design elements such as points, badges, and leaderboards into non-game contexts to increase user engagement and motivation (Woodcock & Johnson, 2017; Largo et al., 2016). These practices aim to create a more fun and immersive experience and ultimately change user behavior and attitudes (Largo et al., 2016). However, the fact that gamification offers the same solutions to everyone is seen as a shortcoming as it may not yield the desired successful results. Students' different preferences or different reactions to the same game is a critical issue that needs to be considered before designing gamification (Antonaci et al., 2019). Adaptive gamification designs offer a solution to this problem with their flexible design features (Böckle et al., 2018). Adaptive gamification takes into account the principles of adaptive learning (Peng et al., 2019), which aims to create a flexible and data-driven personal learning experience that does not follow a single teaching path. Gamification is seen as a promising application with many features in online education as well as in various educational environments (Othman et al., 2023). Online education is one of the most popular forms of distance education where teachers and students can be in different environments. With the many features it provides, it increases the tendency of educational institutions in various countries to transform their face-to-face education into online education (Sadiku et al., 2018). However, this increasing interest in online education has also brought challenges such as student engagement and low motivation (Şahin et al., 2017).

Gamification applications have attracted great interest from educators because they reduce these challenges by increasing student engagement and motivation in online

environments. Numerous studies have investigated the integration of gamification into online learning environments and demonstrated its impact on student interaction, satisfaction, knowledge construction, and engagement (Doumanis et al., 2019; Jitsupa et al., 2022; Shareef & Rauf, 2022; Tsay et al., 2018;). The importance of gamification in online education is better understood with the challenges posed by the COVID-19 pandemic, which has forced a transition to online teaching and learning. This transition has highlighted the need to redefine the presence of the teacher and learning activities in online university teaching, thus underlining the importance of adaptive gamification systems. Furthermore, the implementation of gamification has been associated with addressing issues such as college dropout rates and lack of engagement, especially in massive open online courses (MOOCs) (Klemke et al., 2020). The potential of gamification to increase students' motivation and engagement in online courses has been recognized across various disciplines, including computer science, psychology, and education (Aries et al., 2020; Imran, 2022). Moreover, the application of gamification in online learning has been linked to the development of 21st century skills and sustainable learning (Mårell-Olsson, 2021). In addition, the adaptive nature of gamification in online education creates the capacity to provide a personalized experience for different learner profiles and increases the attractiveness of e-learning platforms (Rebelo & Isaias, 2020). It is known that the positive impact of gamification in applied systems is related to the specific context, user motivation and individual user characteristics in these systems. In this context, it is very important to plan the gamification design construct correctly, which guides the content, user characteristics, activities and tools to be used (Morschheuser et al., 2017).

The widespread use of online environments has made it compulsory for teachers to be equipped in this regard. Actively using online environments involves simple updates with innovative approaches such as gamification to reduce the difficulties experienced by teachers in online environments (Firwana et al., 2021). Designing and integrating gamification systems into the teaching environment is recognized as an activity that can be performed not only by educators but also by students (Li, 2019). However, the lack of gamification design and implementation results in the failure of many gamification efforts. Accordingly, it is very important to determine the gamification design framework and use the right steps before developing gamification applications (Morschheuser et al., 2017). In addition, even if the right design is used in gamification applications, applications designed only for their own target audience do not appeal to students from different languages and cultures (Yamani, 2021). The gamification systems that instructors will develop specifically for their students will further emphasize the motivation, engagement and academic achievement-enhancing features of gamification (Koivisto & Hamari, 2014). Although there are many studies and model proposals in the literature on the theoretical framework of gamification and its impact on learning (Çağlar & Kocadere, 2015; Kaya & Alpan, 2020; Şenocak & Bozkurt, 2020), the number of adaptive online gamification systems developed using gamification theoretical design models is limited (Yamani, 2021).

The aim of this study is to present an adaptive gamification design in online education using the D6 gamification model with its stages and to help researchers and gamification designers in the decision mechanisms that can be used in the gamification process of online systems. The most important feature that distinguishes this research from other studies is that it is a guide that shows educators how to develop a gamification design from beginning to end and a sample gamification system was developed as a result of the research. In this respect, it will contribute to the literature by shedding light on gamification design processes and constituting a sample gamification software.

D6 Gamification Model

In order to successfully implement gamification practices, it is essential to meticulously plan gamification designs step by step (Kapp & Cone, 2012). One of the widely known gamification design models is the D6 design model developed by Werbach and Hunter (2012), which emphasizes systematic gamification planning. This model consists of six design steps. Named after the initials of each of the six design steps starting with “d” (Taşkın, 2020), all stages of this model are intricately linked to motivation theories (Erümit & Karakuş, 2015). The D6 gamification model is widely used in the literature and guides the implementation of successful gamification practices (Şimşek, 2021). The symbolic design of this model is shown in Figure 1.

Figure 1.
D6 Gamification Model

The first phase of the D6 gamification model involves defining the tasks and operations to be carried out. The next two phases involve the identification of the expected player outcomes from the gamification implementation and the identification of behaviors and active participants within the gamification framework (Bartle, 1996). The fourth stage entails the strategic planning of the activity cycles within the gamification process, which includes determining the amount and duration of the cycles as well as defining the feedback mechanisms. The fifth stage emphasizes the important role of entertainment in the gamification process by integrating the element of fun. The final stage is the process of incorporating game dynamics, mechanics and gamification components within the use of appropriate tools. The compatibility of gamification design with the specific context and target audience and the meticulous planning and execution of each stage of the design are directly related to the success of gamification activities (Hamari et al., 2014; Kapp & Cone, 2012; Kovisto & Hamari, 2014).

Methods

Research Design

This study aimed to develop a web-based gamification system for students studying in higher education institutions. In this direction, a design-based research design was used in accordance with the purpose of the study. Design-based research (DBR) emerged in response to the need to systematically examine theoretically grounded educational designs and to advance the integration of design, theory and practice (Collins et al., 2004).

DBR is characterized as an interdisciplinary mixed methods approach. DBR has great potential for the advancement of e-learning environments due to its capacity to facilitate collaboration between individuals from different disciplines and areas of expertise and its flexibility to use a variety of research methodologies tailored to their specific goals. Scholarly reviews conducted by researchers adopting DBR methodologies unquestionably demonstrate the valuable contributions of this research approach to the field of learning (Barab & Squire, 2004; Sandoval & Bell, 2004;). DBR facilitates the harmonious integration of theoretical inquiry and educational practice. This research method serves to operationalize pedagogical theories and illuminate the interplay between educational theory, instructional design and practical application. At the same time, the use of this research method is crucial in revealing the limitations of alternative research methodologies. The primary aim of DBR is to establish robust links between educational inquiry and practical realities, thereby increasing the relevance and impact of educational research (Kuzu et al., 2011). There are possible steps in the process of conducting DBR. As research processes can vary considerably depending on specific contextual factors, the steps in these studies are not as clearly defined as in quantitative research. However, in broad terms, the prescribed course of action is as follows: Initially, the designer formulates and implements the design. Then, the designer evaluates the practical functionality of the design. After assimilating the insights gained from practical implementation, the designer continuously evaluates the design and makes necessary changes. Over time, the design evolves towards a state of robustness characterized by freedom from errors and maximum efficiency (Kuzu et al., 2011). After these processes, the report of the design-based research is created. The possible process steps to be used in design-based research are shown in Figure 2.

Figure 2.
Design-Based Research Process Steps

In the present study, the DBR model was carried out by considering the steps in Figure 2.

Study Group

Purposive (judgmental) sampling method, one of the non-random sampling methods, was used to determine the study group. Purposive sampling method is based on the idea that the inclusion of a certain group in the study group will have a positive effect on the study when the objectives of the research are taken into account (Campbell et al., 2020; Kılıç, 2013). The study group was categorized under two categories: field specialists determined in line with the relevant literature and 34 students taking the Open and Distance Learning course. While the field specialist consisted of 14 people, including two software engineers, four educational sciences specialist, one graphic designer and one front end developer, two gamification specialist

and four educational technologists, the students in the study group consisted of 34 people, 14 of whom were female and 20 of whom were male, who were third-year students studying at the Faculty of Education. Within the scope of the purposive sampling method, the students were selected from those who took the Open and Distance Learning course at a university in the Eastern Anatolia Region in the 2021-2022 academic year. The selection of the study group from the students taking the Open and Distance Learning course is based on the idea that there should be no doubt about their technology usage skills. The visual with information about the study group is shown in Figure 3.

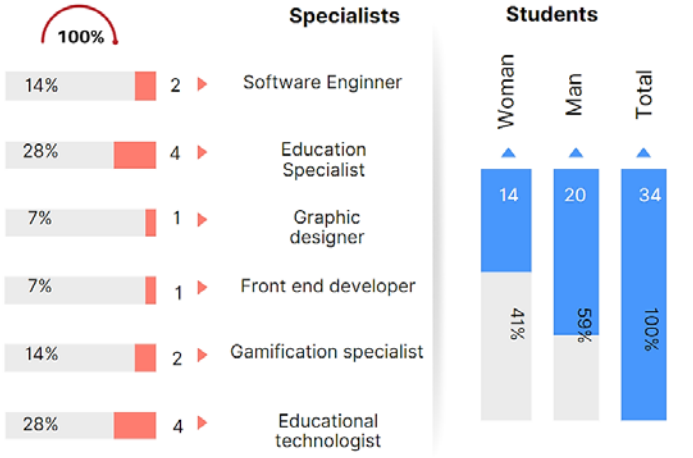

Figure 3.
Information on the Study Group

Design-Based Research Process

In this section, the development stages of the online gamification application from the beginning to the end are included in accordance with design-based research processes. The symbolic design of the research process is given in Figure 4.

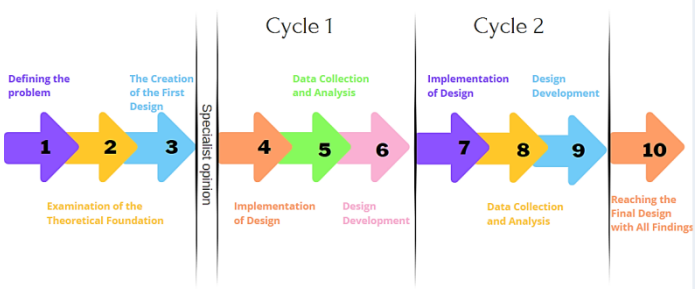

Figure 4.
Symbolic Design of the Research Process

Defining the Problem and Examination the Theoretical Foundation

In order to identify the problem, a detailed literature review process was initiated. Within the scope of the literature review, the difficulties experienced in online environments and the applications that can eliminate these difficulties were emphasized. After the completion of the literature review process, the opinions of four different educational technology specialists specialized in online systems were consulted. As a result of the opinions received and the literature reviewed, it was concluded that students experience various motivational deficiencies in online systems (Ertan & Kocadere, 2022; Gustiani, 2020), they cannot concentrate their attention on the lesson (Cotton et al., 2023), online system design flaws cause cognitive overload (Tuğtekin, 2020), and as a result of all these, they have an inefficient learning experience. To overcome these challenges, the application of gamification has been proposed as a strategy to provide immediate feedback to students in online educational environments (Ertan & Kocadere, 2022). Gamification aims to improve student engagement, motivation and overall perception of online learning platforms by incorporating game elements such as points, badges, leaderboards and rewards into the learning process. Through gamification, students can receive timely feedback on their progress, which allows them to track their performance and make necessary adjustments to their learning strategies. Moreover, the competitive and rewarding aspects of gamified systems attract students' attention and encourage active participation in online learning activities (Bozkurt & Genç-Kumtepe, 2014; Çağlar & Arkün-Kocadere, 2015). For this purpose, it is thought that well-designed gamification activities can offer solutions to negative situations such as lack of learning motivation, negative attitudes towards online learning, cognitive overload and barriers to academic success in online learning environments.

Creation of the First Design

The web-based gamification system was developed for the first two units of the Open and Distance Learning course, "basic concepts of distance education" and "history of distance education", using the infrastructure of wix, a free online web creator. While creating the theoretical structure of the gamification system, the D6 gamification design model was used. While developing the web-based system in accordance with the D6 gamification design, learning objectives were determined in the first step and the behaviors to be acquired as a result of the objectives were decided (Define Objectives / Delineate Target Behaviors). A course syllabus was used to accomplish this. Accordingly, a scenario and a progress guide were prepared and two units that stand out in the acquisition of the target behaviors for the course were added to the gamification system according to the principle of gradualism. The scenario is a guide that clearly states the steps that students will perform when they enter the system and the order of these steps. Through this scenario,

students first created their membership to the gamification site, then completed the first unit games and had the chance to access other games with the game codes they obtained. Then, the players and player types to be included in the system were defined according to the activation of the students in the system (curious, popular, successful, etc.) (Describe Your Players). After the integration of the player types into the system, two different game loops were planned for the two units (Devise Activity Loops), implemented week by week and the basic framework of the gamification system was created by determining the feedback. The game loops designed for two weeks were created using Kahoot, Wordwall and Padlet tools. The fact that these tools include various game elements and can be updated played an important role in their preference. In addition, the ability of these applications to add adaptability to the gamification system was another reason for preference. An example game loop is given in Figure 5.

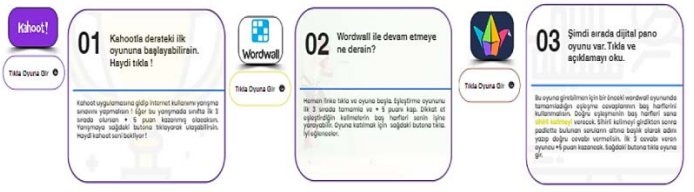

Figure 5.
An Example Game Loop Used in the System

In addition to tools such as Kahoot, Wordwall and Padlet, the DMC (Dynamics, Mechanics, Components) pyramid proposed by Werbach and Hunter (2012) was utilized in designing the system. This pyramid presents game elements in a categorical form and includes the necessary game elements for a system to be a gamification application.
Werbach and Hunter (2012) show the distribution of gamification elements according to the software such as Kahoot, Wordwall, Padlet, which enable the gamification elements to be included in the system externally, and the special design of the website itself in Table 1.

When Table 1 is examined, it is seen that the game elements that should be used in order for the system to be suitable for gamification are fully used both with external software and with the uniquely designed website. In addition, the entertainment factor, which is used in the gamification system and is an indispensable element of games, was included in the system with various multimedia tools (Don't Forget the Fun). Finally, the necessary controls were provided to ensure that the mechanics, dynamics and components of the games (scenario, progression, competition, relationships, challenge, feedback, avatar, badge, leaderboard, etc.) are fully in the system (Deploy the Appropriate Tools).

Table 1.
Werbach and Hunter's (2012) Use of Gamification Elements

		Kahoot	Wordwall	Padlet	Website
Dynamic	Restrictions			x	x
	Emotions	x	x		x
	Story				x
	Progress			x	x
	Relationships	x			x
Mechanic	Challenge	x	x		
	Chance	x	x		
	Competition	x	x		
	Cooperation			x	x
	Feedback				x
	Awards				x
	Queue			x	x
	Winning situation	x	x		x
Component	Successes	x	x		x
	Avatars				x
	Badges				x
	War/Conflict				x
	Leaderboard	x	x		x
	Levels				x
	Points	x	x		x
	Duties				x

Specialist Opinion
After the initial design was completed, the ideas and support of specialists in the field were obtained. In this context, the researcher conducted interviews with 14 specialist, including two software engineers for using the right content, determining the goals and target behaviors and coding the web-based system, four educational sciences specialist for using the right pedagogical approach in the system, a graphic designer and an Front end developer for the visual design of the website, and two gamification specialist and four educational technologists for planning the system in accordance with gamification. The interviews were conducted online and face-to-face (40-60 minutes). In line with the ideas obtained from these interviews, various updates were made to the web-based gamification system.

Design Implementation
After the initial design was presented, the web-based gamification system was applied to the topics under the title of "basic concepts of distance education" in the *Open and Distance Learning course* in one course week. As soon as the students joined the system, they were scored according to their fast registration, the active time they spent in the system and the game loops created with kahoot, wordwall and padlet applications. This game loop

initially included a quiz (kahoot), then a matching application (wordwall) and then a collaborative answer chain (padlet). After the game loop, the web-based gamification system provided students with feedback and a leaderboard. After the implementation, the interview form, which was used as a data collection tool, was applied to the students online and data about the implementation were collected. In line with the data obtained, some improvements were made to the web-based gamification system and the first cycle was completed. Then, the web-based gamification system was updated in line with the results of the first cycle. The current design was applied to the students again with the subject content of "history of distance education", which is another course week. Then, interviews were conducted with the students again and data were collected for the application. In line with the data obtained, the web-based gamification system was updated again and the second cycle was completed. Finally, the final design of the web-based gamification system was obtained by taking into account the data obtained and the interviews with the specialists.

Data Collection Tool

In the study, unstructured interview forms were used to obtain the opinions of field experts and students. Unstructured interviewing is a qualitative research method that allows for open-ended, flexible questioning and allows the interviewee to freely express their thoughts and experiences. This approach does not impose a predetermined set of questions, allowing for a more natural flow of conversation and the exploration of unexpected avenues of inquiry. Unstructured interviews are particularly useful in exploratory research as they provide a rich source of detailed, in-depth information and insight into the interviewee's perspectives and experiences (Osborne & Grant-Smith, 2021). Interviews were conducted with gamification experts and then with students using gamification applications and data were collected through unstructured forms.

In addition, before data collection, an ethics committee report was obtained with the decision of Fırat University Social and Human Sciences Research Board dated 04.11.2021 and numbered 7. All participants in this study participated voluntarily and completed a consent form.

Data Analyses

Content analysis was used to analyze the data obtained through interview forms. The main purpose of content analysis is to explain the data obtained in meaningful relationships, conceptualize them, organize them logically as a result of the emerging concepts and turn them into themes (Yıldırım & Şimşek, 2016). Content analysis aims to analyze the data, to gather similar data under the umbrella of certain concepts and to enable the reader to understand the truth hidden in the data (Büyüköztürk et al., 2012). For this purpose, the data collected with the interview forms were read in detail and the first coding process was carried out. With the first coding process, the categories that the codes can form were determined. After this process, a certain period of time was waited and the relationship between the codes and the categories was reviewed again and some minor changes were made. In the last stage, the findings obtained were defined. In addition, in order to ensure reliability, the researcher provided detailed and realistic information as well as complete and direct quotations from the participants (Büyüköztürk et al., 2012; Dinç, 2015). The quoted information was presented in italic font, with the first part indicating the data source (U=Expert Opinion / Ö=student opinion), the second part indicating gender (K=female / E=male), and the third part indicating the student rank / field of specialization as (Ö-E1) or (U-SE). In addition, two researchers took part in the data analysis and the reliability formula of Miles and Huberman (1994) was used to ensure internal consistency. As a result of the reliability formula calculations, 90% reliability level was reached. This figure, which expresses the consensus between the coders, should be at least 80% (Miles & Huberman, 1994).

Results

The research findings are presented in accordance with the design-based research approach, using cycles to describe the developmental progression of the web-based gamification system together with expert judgment and the user experience at each stage, in line with the data obtained from the students.

Table 2.
Findings from Experts and Students

Category	Code	Software Engineer (SE)	Education Specialist (ES)	Graphic Designer and Frontend developer (UX)	Gamification Specialist (GS)	Education Technologist (ET)	Cycle 1	Cycle 2
Deficiency	Content	x					x	
	Interaction	x						
	Time restriction				x			
	Reports menu				x			x
	Bonus points				x		x	
	Audio usage					x		
	Simple design			x				
	Technical infrastructure						x	
Suitability	Reward-time		x					
	Content - Age		x					x
	Group - Interest		x					
	Icon design style			x				
	Color and color transition			x				
	Points - Level				x			
	Badge - Points				x			
	Implementation Duration					x	x	
	Application Environment					x		

Expert and student opinions on the web-based gamification system are presented in two categories as deficiency and suitability. While the codes under the deficiency category express some features that are seen as missing in the web-based gamification system, the codes under the suitability category express suggestions regarding the suitability of some parameters in the web-based gamification system. A software engineer (U-SE) who thought that the content was missing in reflecting the Access to Information on the Web course stated the following: "*It may be a correct approach to divide the course into six basic units, but the content needs to be enriched*" and requested that the theoretical knowledge in the system be increased. Another software engineer (U-SE) who provided an opinion on increasing student interaction emphasized increasing interaction in the system by saying, "*A social sharing plugin can be added to the site in order to increase student-student and instructor-student interaction in this web-based system. Interaction tools such as comments, likes and following make the system more dynamic*." An education expert (U-ES) commenting on the awards and the time they are given said, "*In order to ensure that the desired behavior occurs, awards should be given immediately after the behavior is performed. At the same time, the frequency period of the rewards given is also important. In this respect, the system needs some updates,*" he said, and made suggestions for the reward-time balance in the system. Another education Specialist (U-ES) emphasized that certain points of the games should be arranged according to the upper age groups with the words, "*Some content may appeal to lower age groups. This creates a problem in terms of the users' interests in the correct gamification planning. Some games need to be updated according to age.*"

A gamification specialist (U-GS), who thought that the system was suitable for gamification applications in many ways, said, "*There must be a time limit in the game cycles and the cycles must be in a gradual relationship with each other. This makes the games more exciting. In addition, a feedback page should be created in order to follow the progress of the students,*" and supported the suggestions regarding the feedback page put forward in the second cycle. Another gamification specialist (U-GS) said, "*Extra points can be encouraging in order to eliminate the demotivating effect of gamification and to provide new opportunities for students who fall behind in the leaderboard,*" and ensured that extra points could be obtained within the scope of the achievements demonstrated in the game cycles. This opinion was also expressed in the first cycle after the first application. Another gamification specialist (U-GS) suggested a harmony in terms of points, badges and levels with the statements, "*The points obtained from the badges should be related to the action performed. Similarly, the points should be distributed in a balanced way in terms of accessibility to the levels.*" An educational technologist (U-ET) who examined the system in detail said, "*Some sounds appropriate to the emotions should be added to the game cycles in gamification. If these sounds are planned in a way that can express losing, winning and competition, gamification will be more effective.*" Another educational

technologist (U-ET) emphasized duration and environment with the words, "*The duration of some planned applications should be appropriate to the application to be implemented and the educational technology tool used,*" and stated that extending the duration of the games could lead to other problems. A graphic designer (U-UX), who suggested that the design be designed with a certain harmony and simplicity, said, "*It is important for the designs used to represent the menu icons and badge to belong to the same design language in terms of integrity and provides simplicity,*" and supported the interface designer who suggested simplicity in colors and color transitions.

After the first design was applied for a week, a student (Ö-E11) stated that the content should be enriched during the first cycle by saying, *"When you compare the content with the course, it seems like a few more games could be added."* Another student (Ö-E12) said, "*Sometimes the leaderboard can be demotivating*" and emphasized the need for bonus points for students who are at the bottom of the leaderboard. A student (Ö-K5) who focused on technical deficiencies said, "*Since it was applied in online courses, sometimes problems caused by the internet could cause our points to decrease in the games."* Another student (Ö-K13) who emphasized the application times of the games said, "*Since gamification applications are applied through technology, the addictive effect of the game caused me to be more involved with technology. Therefore, I can say that I experienced some physical difficulties.*"

The gamification system was updated in line with the findings of the first cycle. Then, the system was implemented for a week in the second cycle. After the implementation, one student (Ö-E6) emphasized the content-age compatibility by saying, *"Some games were designed for lower age groups, which made us bored while using them."* Another student (Ö-K9) emphasized that the reports page should be improved by saying, *"If the details of the reports could be shared on the page created for tracking the results, our mistakes could be seen more clearly."*

Reaching the Final Form of the Design

While developing the web-based gamification system, it was filtered in four different stages: literature review, expert opinion, first cycle (student opinions) and second cycle (student opinions). The design reached its final form in line with the findings obtained at the end of these four stages. The visual for the home page of the web-based gamification system is given in Figure 6.

Figure 6.
Web Based Gamification System Home Page

The developed gamification system consists of six sections: levels, awards, leaderboard, gamebook, avatars and reports. Students were held responsible for both the information in the two basic units on the system (basic concepts of distance education, history of distance education) and some activities they will perform in the gamification system. The students who achieved the highest score in each activity cycle for which they were held responsible were shared on the system's home page under the name "unit stars". All activities of the students on the gamification system and the levels and progress they will achieve as a result of these activities were presented to the students under the "levels" main menu. The visual related to the levels menu is given in Figure 7.

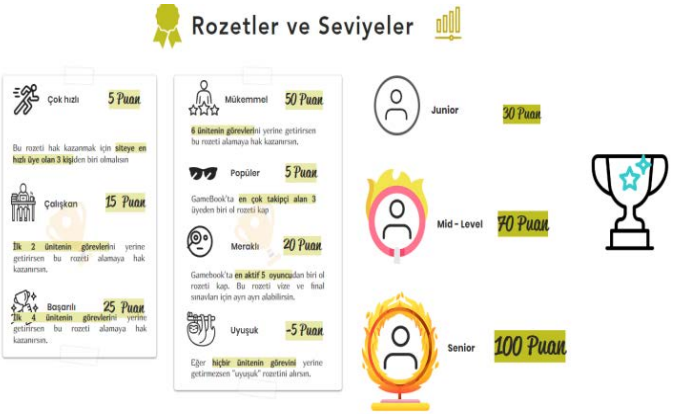

Figure 7.
Badges and Levels Used in the Gamification System

The designed gamification system assigned various badges to students' activities within a scenario, and these badges, which earned students certain points, assigned students to planned levels and provided feedback through the system. Badges and levels were explained to students in detail during the introduction of the system. After the introduction, the student who registered to the system the fastest was given a "very fast" badge and five points. Students who completed the games for one-fourth, half or all of the two basic units that make up the system were

given a “hardworking” badge and earned 15 points, a “successful” badge and earned 25 points, or a “perfect” badge and earned 50 points, respectively. In addition, a social sharing page called “gamebook” was designed in order to ensure relationship and cooperation, which are among the gamification mechanics and dynamics. While the most active player on this page was given 20 points with the “curious” badge for the shares he made, the player who gained the most followers was given a “popular” badge and earned 5 points. The visual of the gamebook social sharing page used in the gamification system is given in Figure 8.

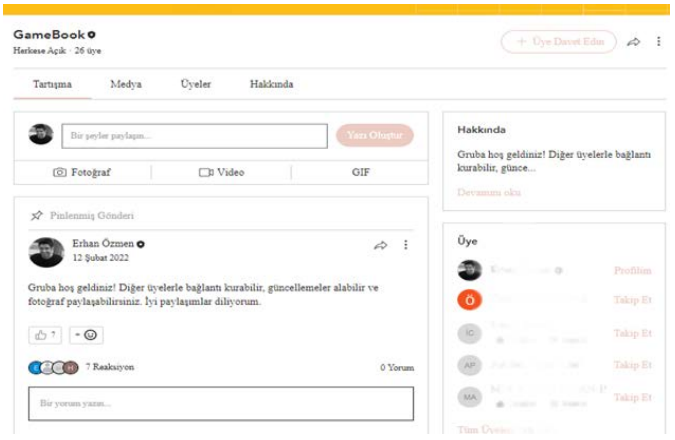

Figure 8.
Social Sharing Used in the Gamification System

Students were assigned as “Junior” (30 points), “Mid-Level” (70 points) and “Senior” (100 points) in the system with the points they obtained thanks to these badges and were entitled to receive certain points. In addition to the points they received from the badges, students were provided with extra points that they could earn according to the activities they performed in the game flow of the two units and added to their student points by the system. Explanations regarding the extra points were given to students under the name of the “awards” menu. The visual of the awards menu is given in Figure 9.

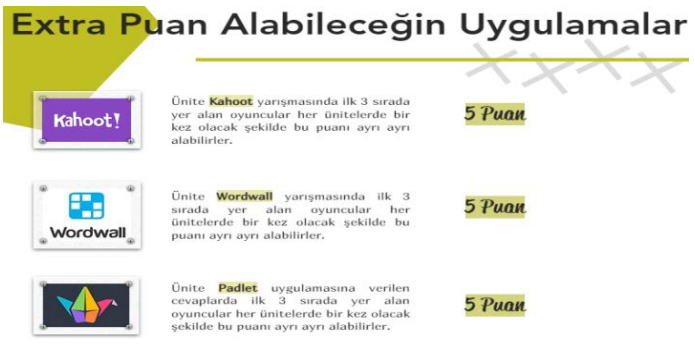

Figure 9.
Extra Rewards That Earn Points in the Gamification System

In addition, the necessary information regarding the points and levels earned by the students was calculated with the leaderboard in the web-based gamification system and shared with the students via the “leaderboard” page. The visual for the leaderboard menu is given in Figure 10 below.

7

Figure 10.
Leaderboard and Scores in the Gamification System

Students immediately determined their own avatars after becoming members of the gamification system and reached certain levels in the system by collecting points through the badges assigned to their avatars with the activities they performed. Avatars serve as an important component in gamification designs. In this context, a page was designed in the web-based gamification system where students can control their own avatars, the badges they received, the points they received, and the number of followers using the avatars menu. The visual of the avatars menu is given in Figure 11.

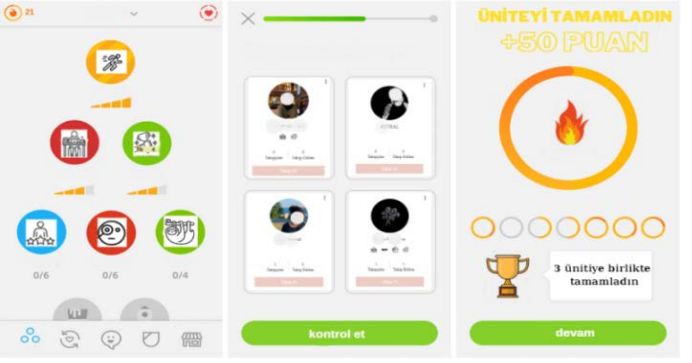

Figure 11.
Page Showing Avatars, Badges and Followers in the Gamification System

While developing the gamification system, feedback was used to enable students to remain more active in the system throughout the process. The results of the Kahoot,

Wordwall and Padlet applications used in the game cycles in the two basic units were given to students on a weekly basis, and the scoring used in the gamification system was transparently transferred to students. Feedback from gamification dynamics undertook functions such as students tracking their success, evaluating themselves and acquiring new learning methods, and increasing course loyalty. The feedback used in the web-based gamification system was presented to students periodically using graphics and visuals under the Reports main menu. The visual of the Reports main menu is given in Figure 12.

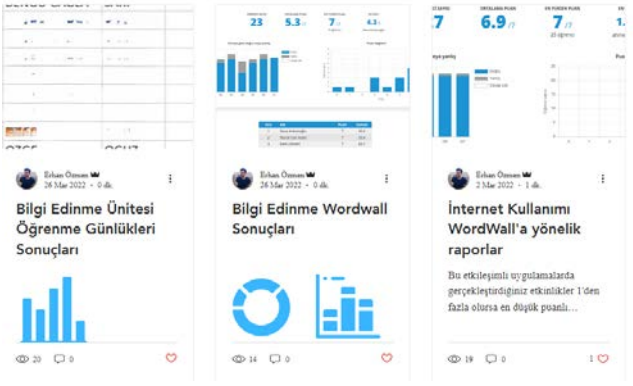

Figure 12.
Screenshot of the Reports Home Page in the Gamification System

Discussion

Within the scope of the current research, the opinions of specialists and students provide some perspectives on various aspects of a web-based gamification system. Software engineers contributing to the research emphasize the importance of content enrichment to support theoretical knowledge and increase student engagement through the integration of social interaction tools. In parallel, some studies in the literature have revealed the positive effects of gamification content enrichment on engagement and motivation (Alsadoon, 2023; Alsawaier, 2018; Aprilia et al., 2023). Within the scope of this research, education specialists underline that timely rewards, age-appropriate content, and establishing a consistent group-interest relationship are essential to maintain user interest and motivation. In line with the current research findings, Aguiar et al. (2019) described the constructive effects of correctly structuring the reward-time relationship on interest and motivation, while Seaborn and Fels (2015) emphasized the importance of using age-appropriate content in the field of gamification. In addition, various studies have shown that gamification groups can benefit from gamification applications in parallel with their interests and cannot create motivation for designs they are not interested in (Tunga & İnceoğlu, 2016; Vilarinho et al., 2018).

Gamification in interface design involves integrating game design principles and methods to improve user engagement and behavioral intention towards information systems and information technology (Cheng, 2021). Although gamification has the potential to increase user experience and motivation, careful evaluation of design elements is essential to prevent a decrease in usability (Johnson et al., 2016). Elements such as game mechanisms, frameworks and specific interface designs play a critical role in influencing user behavior (Cheng, 2021). In this direction, in the current design study, front end developer and graphic designers advocate simplicity, unity and harmony in design creation, emphasizing the critical importance of simplicity and design integrity in keeping the user experience at a high level and achieving the desired results (Torun & Tatar, 2023).

In the developed gamification model, gamification specialists emphasized the importance of including time constraints, feedback mechanisms, and bonus points in gamification to increase participation. Supporting specialist opinions, various studies reveal that time pressure (Aparício et al., 2019) and feedback provide high participation. Similarly, Deterding et al. (2011) suggest that time constraints in gamified games create a sense of scarcity and motivate participation through a perceived urgent need. However, in the current study, the need for feedback in gamification was emphasized in line with the opinions of gamification specialists and students in the second cycle. In line with the current study, it is observed that feedback in gamification applications plays an important role in improving learning outcomes (Qi, 2023), increasing motivation and performance, encouraging deep thinking (Berger et al., 2023), and creating a sense of progress and achievement (Hassan et al., 2019; Sadovets et al., 2022). In addition, the specialist who participated in the study suggested a page that allows students to follow gamification applications as a feedback source. Gürsoy and Göksün (2019) mention that similar page designs can be a common strategy for improving user experience and underline the importance of feedback pages.

In the current study, the inclusion of additional points in gamification was identified as an important factor in increasing student motivation. This result is supported by various studies that reveal the positive effect of providing additional points on student motivation (Sezgin et al., 2018) and engagement (Yüksel & Canlı, 2019). However, in the study, gamification specialist recommended a comprehensive approach that integrates elements such as points, badges, and levels to develop successful gamification applications. Research has indicated that

points, badges, and leaderboards are among the most common gamification elements used in various applications, and these elements contribute to the success of gamified applications when blended with gamification features such as quizzes, rewards, and feedback (Mat & Rahman, 2020). In the current study, educational technologists emphasize the importance of including appropriate sensory elements in game loops to create immersive learning experiences. In parallel with this finding, Matthew et al. (2022) stated that multimedia tools facilitate curriculum presentations and interactive participations required for gamification applications and underlined that elements such as audio-video are brought together in gamification to provide immersive and engaging experiences for users. The findings obtained from the study emphasized the importance of eliminating technical deficiencies in the gamification system, using age-appropriate content and bonus points. In parallel with this perspective, Tunga and İnceoğlu (2016) stated that gamification should be age-appropriate for the target audience, while Attali and Arieli-Attali (2015) revealed that the points used in gamification ensure that students develop a positive attitude towards the course and positively affect the speed of their responses to the tests. When it comes to a general evaluation, it is seen that the opinions of the specialist and students participating in the study provide a perspective compatible with the literature.

Conclusion and Recommendations

In this direction, the following suggestions are offered to gamification designers in the light of the findings and results obtained.

1. Address the need to enhance content and diversify it to appeal to a variety of age demographics to better align with the course curriculum. This may include updating games and activities to ensure that all users are engaged and relevant.
2. Interactive tools such as social sharing plugins, comments, likes, and follows can be implemented to increase interaction between students and between students and instructors. This can create a more dynamic and engaging learning environment.
3. Ensure that rewards are given immediately after desired behaviors to reinforce positive actions. Frequency of rewards should be adjusted to maintain motivation and engagement levels. Balancing the reward-time ratio can be helpful in maintaining user interest.
4. Content that appeals to a variety of age groups should be revised to ensure it is aligned with the target audience. Age and gamification design compatibility can be critical to success.
5. Time constraints should be added to game loops to add excitement and progression. A detailed feedback page should be developed to allow students to track their progress and receive constructive feedback on their performance.
6. Extra points should be offered as incentives to motivate students and eliminate demotivating effects. Continuous participation and progress can be encouraged by ensuring that extra points are available for achievements in game cycles.
7. A balanced relationship should be established between points, badges, and levels to ensure consistency and accessibility. The overall gamification experience can be improved by linking points obtained from badges to specific actions performed.
8. Appropriate sounds reflecting emotions such as winning, losing, and competing should be included in the gamification system to enhance the immersive experience. It should be ensured that the duration of the game applications is compatible with the educational technology tools used to prevent potential problems and maximize user engagement.
9. The interface should be designed with simplicity and consistency by ensuring that menu icons and badge designs adhere to the same design language in terms of integrity and user-friendliness. Consistency should be maintained in color schemes and transitions for a visually appealing and intuitive user experience.

Ethics Committee Approval: Ethics committee approval was obtained from Fırat University Local Ethics Committee (Date: 04.11.2021, Number:7)

Informed Consent: All participants in this study participated voluntarily and completed a consent form.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - EA-AÜK; Design- EA; Supervision-AÜK; Resources- EA-AÜK; Data Collection and/or Processing- EA; Analysis and/or Interpretation- EA; Literature Search-EA; Writing Manuscript-EA; Critical Review-AÜK.

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Primary School Teachers' Views on the Integration of Sustainable Development into Learning

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ABSTRACT

In this study, we sought an answer to the question of what can be done to integrate sustainable development into learning environments in the context of teacher opinions. We followed a case study design to achieve this goal. The research's study group consists of 15 primary school teachers from northwest Turkey, who were chosen using criterion sampling. We used an interview form to gather research data and analyzed it with content analysis. Teachers think incorporating sustainable development into the learning environment brings many benefits to children. According to findings, sustainable development provided many gains to students. Findings in the context of teacher opinions were: 1) eco-friendly behavior; 2) literacy; 3) awareness of green technologies; and 4) awareness of green professions. In this context, sustainable development should be integrated into primary school curricula. Also, in the study, we emphasize a sustainable education for a sustainable future. In this context, the outputs of sustainable development should be used effectively in education and training environments.

Keywords: Sustainable development, primary school teachers, green technologies, green professions.

Introduction

Our institutions' and cities' physical and cultural structures and attitudes unconsciously link nature to disasters (Sanera & Shaw, 1999). The distinction between humans, other animate or inanimate beings, and machines is made more difficult by rapidly advancing digital technology, which also portrays man as a supernatural being. The physical skills and feelings of our children, who spend less time in nature, blunt their feelings toward nature, and their experiences are getting worse, despite the post-modern idea that reality is only a fiction promising people limitless possibility (Louv, 2005). Because of the lack of experiences, nature for new generations becomes an abstraction rather than a reality. It is treated as a commodity that can be watched, consumed, dressed in, and even ignored daily (Louv, 2005). The most dreadful act of human interference with nature is the introduction of hazardous and even deadly materials into the oceans, rivers, air, and soil (Carson, 1962). The world's ecological balance has been upset by its production and consumption practices over the past 200 years. The environment in which we live is contaminated by industrial flue gases, particularly by the toxic wastes produced by the chemical industry (Yücel & Ekmekçiler, 2008).

Environmental concerns compel us to consider how our actions will affect future generations of people (Des Jardins, 2006). Preschool and primary school years are crucial for preventing environmental problems, which are getting worse, and for resolving them, particularly in terms of early intervention, just as they are for all societal segments. Young children will benefit from environmental education studies because they will learn more about the environment, find solutions to environmental issues, and become more sensitive to the environment. Now that the need for environmental education has been acknowledged, it is time to step back and reevaluate the strategies and messages used in this education (Sobel, 2014). Intervention programs in the early years are crucial for people to become conscious of their consumption patterns. First and foremost, the program's practitioners must be aware of something to raise awareness.

Sustainability and Sustainable Development

Sustainability maintains ecological system diversity and reproduction. In other words, sustainability ensures the continuation of human life and natural resources. The foundation of sustainability is the efficient use of natural resources, the reduction of waste, the recycling of resources, and environmental protection. On the other hand, sustainable development refers to development that meets the needs of present generations without compromising the needs of future generations. Over time, the depletion of the ozone layer, the contamination of potable water, the excessive accumulation of nitrogen in the soil, and negative changes in biodiversity highlight the importance of sustainable development (Rockström et al., 2009). In this context, education is portrayed as the most fundamental process for ensuring sustainable development. Because education for sustainable development enables the development of knowledge, values, and skills in individuals so that they can participate in decisions about what to do locally and globally to improve the quality of life of individuals without harming the future, it is essential (Hopkins & Mckoewn, 2002; Summers et al., 2000). In this regard, schools should implement a systematic environmental education program from an early age in order to ensure sustainability. Sustainable environmental education programs are essential for developing individuals' attitudes, values, knowledge, and abilities.

The goal of sustainable education is to equip people with a variety of skills, including self-expression, mutual evaluation of natural and artificial systems, insight into cause-and-effect relationships, communication and teamwork with others, behavioral orientation, and critical, creative, reflective, and analytical thinking (Hopkins & McKeown, 2002). In this context, the three basic functions expected from sustainable development-oriented education can be summarized as informing, instilling sensitivity and creating behavioral change.

The Relationship Between Environmental Education and Sustainable Development

The first step in becoming an environmentally conscious citizen is to behave responsibly. Numerous internal and external factors impact environmental awareness, which is recognized as the first stage of the learning process for environmentally sensitive behaviors. However, more than awareness is required. In addition to being environmentally conscious, one must also have a fundamental understanding of environmental issues, experience anxiety, and have the drive to act (Kamaruddin et al., 2016). People need to be concerned about the environment to engage in these behaviors. Concern over environmental issues is called environmental anxiety (Eom et al., 2016). People with severe environmental concerns also exhibit highly environmentally friendly behavior (Albayrak et al., 2013). Environmental awareness influences people to act environmentally friendly (Kim & Damhorst, 1998). According to Bang et al. (2000), people who are very concerned about the environment are ready to pay more for renewable energy. Atay et al. (2019) determined that environmental concerns lead individuals to use environmentally friendly practices. According to studies, people who care about the environment and have a positive attitude toward ecologically friendly products are more likely to buy them (Hasnain et al., 2020; Lasso, 2020). Ling Tan et al. (2019), Kar-Yan and Yazdanifard (2014), Suki (2013), and Bang et al. (2000) determined that consumers with environmental concerns and sensitivities are more inclined to buy environmentally friendly products.

Environmental identity is another concept related to environmental education. Environmental identity is the meaning that an individual attributes to himself the environment (Stets & Biga, 2003). Environmental identity is a component of how individuals perceive the world, form relationships with the environment, and form self-concepts, such as the significance of the environment to the individual. The notion of environmental identity is an integral part of our identity. Environmental identity refers to individuals' self-perceptions about the environment, identification with the environment, and their relationship with the environment (Clayton, 2003; Kals & Ittner, 2003). Individuals with an environmental identity consider the environmental consequences of their actions when making decisions. This circumstance influences the individual's consumption habits (Payne, 2001).

Many academic disciplines in educational institutions include sustainability and sustainable development in the name of environmental education. This is one of the factors contributing to teachers' need for environmental knowledge (Waswala et al., 2019). However, alternate solutions should be developed to overcome this ignorance and address environmental issues (Ongon et al., 2021). All curricula should specifically cover ideas like eco-friendly technologies, green jobs, and environmental citizenship because 21st-century technology influences one's awareness of the environment. For protecting the environment in this context, choosing eco-friendly technological tools, and showing interest in green careers are crucial. As a result, the technological tools people prefer are related to the environmental education people have received and their environmentally friendly behavior.

Environmentally friendly behavior is defined as the capacity to protect the environment, address environmental issues, and engage in actions that support the sustainable exploitation of the environment (Klein & Huffman, 2013; Schultz & Kaiser, 2012). Individuals' actions that support environmental sustainability can be summed up as practices like conserving energy, washing clothes less frequently, and recycling paper waste (Lange & Dewitte, 2019; Mesmer-Magnus et al., 2013). These actions are also among the fundamental conditions for sustainable development.

Current Study

Teachers play a significant role in helping students acquire ecological citizenship skills and ecological literacy (Ferreira et al., 2016). An ecologically literate person gathers information using scientific method skills, establishes cause-and-effect relationships, and ascertains the environment's biophysical, social, and interrelationship components (McBride et al., 2013). Although science provides short-term solutions to some environmental issues, there is a need for a change in which eco-friendly practices are adopted (Ferreira et al., 2016). To ensure that future generations live in a healthier environment, raising ecologically literate people is essential (Yoleri, 2012). According to this viewpoint, ecological literacy instruction should be multidisciplinary and comprehensive, view people as a part of nature, concentrate on how people interact with ecosystems, and show how to achieve sustainable development through this instruction (Hammerstein et al., 2019).

Environmental education is crucial for maintaining a sustainable way of life and protecting and advancing natural education (Suarlin & Ali, 2020). Environmental education seeks to help people and societies comprehend the nature of the natural world and to impart environmental knowledge, values, attitudes, and practical skills (Suarlin & Ali, 2020). It is also true that, especially in developing nations, people must have the correct information, abilities, and attitudes about sustainable development (Debrah et al., 2021). People should be given environmental awareness training and encouraged to adopt it as a way of life in order to protect the environment and ensure sustainable development (Bertiz, 2010). Education is just as crucial for sustainable development as eco-friendly activities and environmental empowerment awareness, which can only be developed slowly by offering short-term education or training (Nasibulina, 2015). Sustainable development encourages participation, activity, and education about the environment, equality, and social justice. Because it can develop consciousness and mold human behavior, sustainable development is essential (Nasibulina, 2015). In this setting and the context of teachers' opinions, we sought an answer to the question of what can be done to integrate sustainable development in learning environments. Within the parameters of the information, we collected from primary school teachers, we structured our research design.

Methods

Research Design

In order to ascertain primary school teachers' opinions on sustainable development and environmentally friendly technologies, we conducted the research as part of a case study.

Participants of the Study

The study was conducted with teachers working in different primary schools in the districts of Istanbul in the 2023-2024 academic year. We identified classroom teachers with at least ten years of experience who had previously worked in public primary schools before we began the research-15 Istanbul-based classroom teachers who are participants in the study. Using the criterion sampling technique, one of the purposive sampling types, we selected the research participants. In this situation, our criteria would be being a primary school teacher, having at least ten years of experience, and having experience teaching about the environment, sustainability, sustainable development, and environmentally friendly technologies in the classroom.

Data Collection and Research Context

We used semi-structured interview to gather the data for the study. Eleven interview questions were written during the development of the interview form after a review of the pertinent literature. To get field experts' opinions, the form was sent to two primary school teachers, four academicians, who had doctoral degree in primary school education. We modified some questions in response to expert feedback and eliminated two questions to create a pilot application. As a result, prior to the application, we assessed the questions' clarity and gained experience. In keeping with the direction of the research, we asked a few questions that are referred to as probes to increase the richness of data in the interview questions and deepen the participants' perspectives.

We examined the agreement between encoders regarding the interview form with Miles and Huberman's (1994) formula and determined the agreement as .85. The final version of the form includes nine open-ended questions (i.e., What might be the results of integrating sustainable development into educational environments? What are the contributions of integrating sustainable development into

educational environments for children? What are the contributions of sustainable development to providing children with green technologies and professions? what are the positive outcomes of sustainable development? What literacy is required for sustainable development?). We recorded the data of our face-to-face interviews with the teachers with a voice recorder to prevent data loss.

Data Analysis

We used the content analysis technique to examine the data gathered. The process of scanning qualitative texts for recurring words and themes, distilling them down to any qualitative data, and making sense of them is called content analysis (Patton, 2015). We first read all the data through the content analysis. The data was then put through the extraction process. The data were coded in the second stage, and we arrived at the themes by connecting the codes. In the study, we made coding in the form of brief notes in this direction. By combining repeated coding, we came up with themes (categories). In this study, we used creative variation. By deriving the coding from the data and the themes from the coding in the data analysis, we made abstraction in this direction using an inductive method. We coded the participants in the study with the letter "T" without disclosing their identities. For instance, "T-1" represents the first participant, and "T-15" for the fifteenth.

Reliability and Validity

Various methods were used in the research to collect accurate and trustworthy data. First, we established that research participation was entirely voluntary. Without disclosing the names of the participants, we also reported the research findings to the research under a fictitious name. Additionally, to ensure validity, the data were voice-recorded to prevent data loss, verified by independent researchers, given in-depth descriptions, and had one-to-one quotations from the teacher's statements to support the analyses. We evaluated the applicability of study results in various contexts. In the study, we looked at the similarities and differences between the coding and theme creation done at various points in the later analyses. As a result, we coordinated and double-checked the coders' compatibility.

The Role of Researchers and Ethics

We first received approval from the university's social and human studies ethics committee before beginning the study. Ethics committee approval was obtained from Yildiz Technical University Social and Humanitarian Ethics Committee (Tarih: 05.12.2023, Sayı: E-2023/12). The participants were also informed that their interviews would be audio recorded, and we obtained their verbal and written consent. We made the teachers aware of the research data's confidentiality. Additionally, we let them know that they could leave the study at any time and not have to answer any questions they didn't want to. We took steps to ensure that the interview was conducted as impartially as possible during the data collection process. In this regard, we were careful not to assign judgment to the participants' actions and words or to instill expectations in them.

Results

This study examines the motivations for primary school teachers to incorporate sustainable development into their teaching practices. Teachers believe incorporating sustainable development into the learning environment has numerous advantages for students. According to the teachers, we communicated to students the achievements of sustainable development education through themes. The opinions of teachers four categories.

These themes are;

1) Eco-friendly behavior,
2) Literacy,
3) Awareness of green technologies,
4) Awareness of green professions.

These themes are supported by direct references and comments. Below are detailed descriptions of the themes.

Eco-Friendly Behavior

According to primary school teachers, including sustainable development problems in their teaching methods has many advantages for the students. Teachers believe that through this process, kids learn how to behave in a way that is good for the world. The behaviors of the students toward the environment are compiled in Table 1.

Table 1.
Eco-friendly Behavior

Theme	Codes	Sample Evidence	f
Eco-Friendly Behaviour	Strives to reduce harm to the environment	In the learning process of sustainable development, students become aware of the damage caused by people to the environment, they think about what they can do (T-7)	4
	Tries to strike a balance between man and nature	I see that students are trying to understand nature, and people express what they can do to protect it by not doing (T2).	3
	Uses resources efficiently	I can say that my students have gained awareness about recycling. Now they use the paper they will use more carefully (T-5).	2
	Efforts to avoid waste and saves money	We took out the ecological footprint of our classroom, the children noticed that we produced a lot of paper waste, they tried to reduce it by producing many ideas (T-3).	2

Teachers assert that a learning environment focused on sustainable development raises students' knowledge of preventing environmental harm and preserving the environment. According to T-11, "sustainable development makes it possible to use agricultural territory effectively and distribute resources equally among all people. Every child can grow up in a just society in this manner". Additionally, it broadens their understanding of the efficient use of agricultural lands and water resources and the fair use of environmental resources. K–6 "I believe that through stewardship, we can use more of the planet's finite resources. In order to prevent problems for future generations, we must build a sustainable society".

Literacy

Teachers stressed that when learning processes include sustainable development, students' environmental literacy improves. In the teachers' opinion, these kinds of literacy should be present in everyone. Children will become more environmentally conscious due to these literacy activities, and they will grow to believe that the environment is a companion rather than an adversary. Table 4 contains information on these reading skills.

Table 2.
Literacy

Theme	Codes	Sample evidence	f
Literacy	Water Literacy	… they know more about the importance of water saving and water (P-5)	2
	Agricultural Literacy	… I can say that they can do basic planting work (P-10)	2
	Food and Nutrition Literacy	… acquire health nutrition knowledge (P-7)	2
	Environmental Literacy	… take action to protect the health of the environment (P-7)	1
	Recycling and Recovery Literacy	… started to prefer recyclable products (P-2)	1
	Ecological Literacy	… they strive to reduce their carbon footprint, protect and diversify the ecological balance, plants and animals (P-4)	1

Teachers reported that incorporating sustainability and sustainable development into the educational process helps students develop an understanding of water, farmland, food and nutrition, the environment, recycling, and ecological literacy. For instance, K-8 asserts that "we must place significance on sustainable development if we want children to become ecological citizens. Another teacher stressed the need for ecological citizens to uphold their and the natural world's rights. One should be ecologically literate for protection because nature has rights similar to those of people (T-9). The teachers believe that children are the future's adults and that their literacy will help them become responsible citizens. E.g.

> K-4 "Ensuring human growth is the primary goal of development. However, if we disregard sustainability as we progress, we endanger the future of our children. This balance should be taken into account as much as feasible as we progress. Materials are scarce, but if we use them wisely, they can last for many years. In this way, we should teach our kids about the world while we are raising them. A kid should be educated in ideas like recycling, water conservation, and food safety".

Awareness of Green Technologies

The teachers claim that incorporating sustainable development into the learning process helps students understand how to use green technology. Students' knowledge of numerous green innovations has increased in a sustainable learning process. Table 3 lists green tools that teachers believe can aid in sustainable development.

Table 3.
Awareness of Green Technologies

Theme	Codes	Sample evidence	f
Awareness of Green Technologies	Electric School Buses	I never forget, I learned that for the bus service he came to school, my teacher said that if the buses were electric, it would harm the environment less (T-3)	4
	Waste Management Systems	Particularly, students' awareness about residues has increased, they are willing to recycle wastewater (T-7).	3
	Schools That Produce Their Own Energy	I'm a student, teacher, can't we meet the energy needs of our school with solar energy? His saying made me proud (T-11).	2
	Rechargeable Battery	We can understand that students are sensitive even in the technologies they use. Now most of them prefer rechargeable batteries instead of disposable batteries (T-6).	2

In order to guarantee sustainable development, primary school teachers emphasized the use of eco-friendly green technologies: Concerning sustainability, we ought to prioritize environmentally friendly innovations first (T-1). Teachers claim that as part of the sustainable development process, students have learned about various green technologies, including the need to build more schools that use renewable energy sources, rechargeable batteries, leftover management systems, and electric school flings. Supporting implicit learning will, in the opinion of the teachers, make children aware of sustainable growth. According to K-2, environmentally friendly technologies should be used in schools to support this scenario. Children will thereby automatically comprehend the significance of these technologies. Only this year's events can be communicated to future generations. According to the teachers, our nature is under tremendous threat. Technology magnifies this impact. Learning environments should incorporate sustainable environmental instruction from an early age to be safe. Individuals can only become conscious in this manner. E.g.

> K-9 "Over the past century, the number of people has more than twice to eight billion. Even though we cannot entirely stop energy use and environmental damage, we can limit it. I believe that by utilizing resources sustainably and incorporating green technology into every industry, we can meet the needs of all living creatures while preserving the environment".

Awareness of Green Professions

According to teachers, incorporating sustainable development into the classroom sparked students' interest in green careers. The occupations that students find appealing are mentioned in Table 4.

Table 4.
Awareness of Green Professions

Theme	Codes	Sample evidence	f
Awareness of Green Professions	Renewable Energy Engineers and Technicians	My students were particularly interested in renewable energy, I heard many of them say that I will become an electrical engineer and produce green energy (T-9).	3
	Green Environmental Architect	One day I will never forget, a student of mine said that he would become an architect, but the buildings they made would be environmentalists, not an ordinary architect (T-5).	2
	Organic Agriculture Engineer	Unfortunately, we are not in a good position in agriculture, we should give environmental education to our students, especially for organic farming, most of which are GMOs (T-2).	2
	Natural Lawyer	My studies have participated in the environmental education process with interest, some say that they will become a nature lawyer to protect nature (T-8).	1

According to teachers, incorporating sustainable development into the learning environment heightens students' awareness of green employment. These professions include energy engineering, architecture, law, and organic agriculture, according to teachers. One educator stated that green jobs could be incorporated into any profession and are simple to convey to students of all ages, from kindergarten to college (T-10). The proliferation of these occupations in society will promote sustainable development and encourage individuals to engage in eco-friendly conduct. Thus, the fractured bond between humans and nature will be repaired, and we will leave future generations a cleaner, healthier, and more habitable world. E.g.

> T-3 "We should start exposing kids to verdant meshes at a young age. We should teach green techniques in the same way that we teach other professions, such as education, law, engineering, and firefighting. By increasing kids' knowledge, we canmake the world a better place to live.

Additionally, children will advocate for sustainability in all of their potential careers".

T–11 "In the interest of a livable world, we should educate our children about green jobs. We should emphasize to students that every profession has a responsibility to preserve the environment when we are instructing. Because unless environmental awareness becomes a social force as opposed to an individual pursuit, we cannot succeed. From the very beginning, the foundation for this should be carefully taught in schools".

Conclusion, Discussion and Recommendations

This study aims to determine why elementary school teachers should incorporate sustainable development into their lesson plans. Teachers claimed that by including sustainable development in the learning, the setting offers children several advantages. Teachers contend that students benefit significantly from learning settings that place a high priority on sustainable development. It is conceptualized as 1) eco-friendly behavior, 2) literacy, 3) awareness of green technologies, and 4) awareness of green professions.

According to the teachers, a learning process founded on sustainable development aids in developing environmentally friendly behavior, as the findings emphasize. Teachers stressed that students made gains in the process in question, including making efforts to lessen environmental damage, attempting to create a balance between humans and nature, using resources effectively, attempting to prevent waste, and making savings. Research in the literature backs up what we found. According to research, being in tune with nature and being social positively affects students' well-being (Pirchio et al., 2021). It is stated that natural environment experiences promote recovery from stressful experiences and enable individuals to recover their cognitive and emotional resources that are depleted during their daily life tasks, thus allowing people to adapt to the environment and supporting well-being (Nilsson et al., 2010). Another point is that most studies examining how environmental education initiatives have affected knowledge and attitudes have found a correlation (Liefländer & Bogner, 2014; Schmitz & Da Rocha, 2018). In line with these gains, it is meaningful for teachers to incorporate environmental education into the learning process from the early years.

Primary school students are the subject of this study. As a result, we emphasize the value of the Internet in the early stages of learning about the framework of sustainable development. Similarly, Uraş & Zengin (2019) suggested that education for sustainable development should begin in childhood. At this point, providing individuals with a high-quality education from a young age will enable them to view issues from the viewpoint of social justice and support the social objectives of sustainable development (Barrett & Sorensen, 2015). Future-focused and strategic planning instruction in sustainable development will assist students in developing a more sustainable economy, environment, and societal order (Bell, 2016). As a result, the curriculum should include developing methods for teaching about sustainable development and global citizenship (D'Cruz & Osipova, 2011).

Another study finding is that teaching about sustainable development helps kids acquire some level of environmental literacy. According to the teachers, incorporating sustainable development into education processes helps the learning of literacy, such as "water literacy, agricultural literacy, food and nutrition literacy, environmental literacy, recycling and recovery literacy, ecological literacy" in children. The successful agreement of environmental sustainability and sustainable development depends on these literacy skills. The literature also backs up the results of our study. It draws attention to how crucial literacy is in the writings. For instance, Hui-Shuang (2018) emphasizes the significance of water literacy in developing a community that conserves water, given the deficiencies in students' fundamental water knowledge. The research done by Samendra et al. (2016) suggests a need to open creative courses in which water literacy is addressed for health, culture, and the future, given the deficiencies in students' basic knowledge of water.

It is well known that the idea of food literacy encompasses a variety of topics, including the environment's sustainability, the world's food system, health-related habits, and food and beverage culture and skills (Pendergast & Dewhurst, 2012). According to Zoellner et al. (2009), nutritional literacy is similar to health literacy in that it refers to a person's ability to access, process, and comprehend basic nutritional knowledge. According to Cimbaro (2008), nutritional literacy is the ability to use words to communicate knowledge about the connections between food systems and biological, social, and ecological systems. The significance of comprehending nutritional information, acting on this information, and continuously setting goals for healthy eating and nutrition were stressed by Block et al. in their 2005 study. As a result, the students' findings about food literacy acquired as part of our study's scope are crucial. The research supports our conclusions. According to Frick and Spotanski (1990), agricultural literacy should also include knowledge of the techniques and procedures employed in agriculture, as well as the fundamental agricultural ideas and how agriculture affects

society. According to Leising et al. (2003), how elementary school teachers incorporate agriculture lessons into the curriculum affects how literate their students are about agriculture. Similar to how teachers in this research said they included sustainable development to help students become more literate in agriculture. The pupils' ecological literacy improved; it was determined in the end. It also enables those with ecological literacy to be considered ethical customers. The structuring of individual learning processes that are impacted by sociopolitical, cultural, historical, economic, and ecological circumstances is referred to as ecological literacy (Hares et al., 2006). This conclusion is connected to the contexts mentioned in the literature at this juncture.

Another study finding indicates that a sustainable development curriculum raises students' awareness of green technologies. Teachers claim that integrating sustainable development into educational processes helps students learn about eco-friendly technologies like rechargeable batteries, trash management systems, electric school buses, and self-sufficient schools. Alternatives like green energies are possible to protect the ecosystem. According to Doan (2001), 15% of the world's energy needs in 2050 will be met by solar energy. In this situation, interest in eco-friendly innovations will grow daily. Solar energy panels can be installed on the roofs of school buildings to accomplish this efficiency (Parfit, 2005). Green technologies can also be produced by efficiently using renewable energy sources like solar and wind. With solar energy, environmental pollution brought on by fossil fuel use can be stopped, as well as the pace of growth in energy imports. Systems designed to generate solar energy take energy straight from the sun without using combustion-related gases (Parfit, 2005). An endless supply of energy can be obtained by using wind turbines singly and in groups (Walker & Jenkins, 2001). Therefore, encouraging the use of green technology and energy from a young age will help to preserve the ecosystem. The results of our study contribute to the objectives of the future of our society in this way.

Another study finding indicates that students become more knowledgeable about green careers through a learning method based on sustainable development. The teachers believe that incorporating sustainable development into educational procedures will increase students' awareness of careers such as those held by lawyers for the environment, organic agricultural engineers, green environmental architects, and engineers of renewable energy. These jobs are incredibly productive endeavors that safeguard the ecosystem and biodiversity, use less energy, raw materials, and water, and produce less waste and pollution, or none (UNDP, 2008). Increased energy efficiency, renewable energy, mass transit, recycling, an increase in environmentally friendly companies, sustainable resource use, and environmental services are all examples of green employment (ILO, 2008; ILO & OECD, 2012). Green careers are advantageous for the environment and people's well-being. Employee efficiency is increased by green offices with plenty of natural light and ventilation, as well as by how well-lit and fresh the environment is. The literature supports our results in this area.

This research has some restrictions. Considering these restrictions and the results of our research, we would like to make some recommendations. Only the inclusion of teacher opinions is restricted in our study's top goal. Other research may examine the perspectives of students' parents. Another time, no other data collection methods were used in the research; only interview management was used. Using strategies like monitoring can enhance future research. Participants in our research total a comparatively small number. Other experiments can be done with more participants. In the research, the teacher's perspective was used to evaluate the students' accomplishments; the students themselves were not considered. It is possible to include students in future research. Quantitative measurement methods can also assess the benefits of sustainable development for students. Our study's teachers who incorporated sustainable development into their classroom claim that the students benefited in various ways. Therefore, professional development programs for more teachers can be designed to help them create learning environments where students can demonstrate environmentally friendly behaviors, improve their environmental literacy, and become conscious of green careers and technologies.

Ethics Committee Approval: Ethics committee approval was obtained from Yildiz Technical University Social and Humanitarian Ethics Committee (Date: 05.12.2023, No: E-2023/12)
Informed Consent: Written informed consent was obtained from pre-service teachers who participated in this study
Peer-review: Externally peer-reviewed.
Author Contributions: Concept-ME; Design-ME; Supervision-ME; Resources-ME; Data Collection and/or Processing-ME; Analysis and/or Interpretation-ME; Literature Search-XX; Writing Manuscript-ME; Critical Review-ME;
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Identification of Performance, Motivation, and Support Needs in Coding Education Provided for the Students with Mild Intellectual Disabilities

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ABSTRACT

Coding education, which enhances the computational thinking skills of K-12 students, is increasingly integrated into the curricula of various countries. However, such education is often excluded from the curricula designed for students with special needs. A review of the literature indicates a significant scarcity of studies dedicated to the coding instruction process for this population. To effectively integrate coding and computational thinking into the curricula for students with special needs, it is essential for educators to understand the appropriate materials and instructional supports that can enhance student motivation and participation during coding lessons. This study aims to evaluate the performance of a secondary school student with mild intellectual disabilities in coding education, with a focus on the materials used, student motivation, challenges encountered during the instruction, and the specific support needs of the student. Employing a holistic single case design, the research incorporates the perspectives of a secondary school special education student regarding their coding education, alongside observations made by the researcher. The findings indicate that the participant actively engaged in the coding education, with block-based coding activities being the most motivating among the various coding activities offered. Furthermore, the study identifies the essential individual supports required by the participant, which include concretization, verbal clarification of the tasks to be performed during each session, and access to the block-based coding platform.

Keywords: Special education, mild intellectual disability, coding, motivation, computational thinking.

Introduction

Since computational thinking is related to useful and applicable competences in individuals' daily lives, it is adopted worldwide as one of the 21st century skills that individuals should develop (Nordby et al., 2022; Wing, 2011; Zhang & Nouri, 2019). Although different nomenclatures such as computational thinking, computer thinking, computational thinking are used in the national literature for Computation Thinking, it is mostly referred to as computational thinking (Demir & Seferoğlu, 2017; Ilic et al., 2016; Şahiner & Kert, 2016; Yecan et al., 2017). Aho (2012) defined computational thinking as 'the thought process that involves formulating problems so that their solutions can be represented as computational steps and algorithms'. Computational thinking can help students think through unstructured problems, interpret data, and learn to communicate using computers (Lee et al., 2014). Coding teaching is frequently used in the acquisition of computational thinking skills (Akçay & Çoklar, 2016). In fact, coding has been included in the K-12 education curriculum in many countries (Lamprou & Repennig, 2018). While computational thinking is integrated into the K-12 curriculum, the access of special students to this education is excluded from the discussions (Bouck & Yadav, 2020). According to Kafai and Burke (2015), for these inclusions to truly make sense, a broad range of students must receive effective coding instruction that engages them in personally meaningful ways. Therefore, it is thought that this goal can be achieved by including coding education in the individual education programmes of not only students in regular classes but also students with special needs.

According to the report published by MEB (2022), there are 453 thousand 29 students with special education needs in our country (MEB, 2022). In 2017, with the curriculum change made in our country, coding education was included in the information technologies and software course curriculum of secondary school 5th and 6th grade students. Since this date, coding education has been given in regular classes with information technologies teachers who are experts in the field, with computer-free, block-based and robotic coding activities. However, the special education regulation does not include information technologies or coding courses at any grade level (MEB, 2018). It is thought that the fact that these special students, who are prepared for adult life with individualised curricula, do not receive information technologies and coding education causes them to become more disadvantaged compared to students receiving regular education. While the International Society for Technologies in Education (ISTE) provides standards for the interdisciplinary integration of coding, it also discusses what educators should do to ensure that students develop computational thinking skills to solve the problems they face (ISTE, 2018). However, it is seen that students with special needs are not included in these discussions and there is not enough research in the literature on how coding instruction can be applied to these students (Israel et al., 2015).

Snodgrass et al. (2016), in their study with two students with mild intellectual disabilities attending the 5th grade of primary school, observed the supports that students needed in acquiring computer use skills and stated that students with disabilities should participate in computer classes and receive the supports they need as in all other areas.

Ladner and Israel (2016) categorised the difficulties experienced by special education students in their educational life into three categories: accessible materials, teacher attitudes and pedagogical approaches (See Figure 1) and stated that the category of teacher attitudes is the biggest category of difficulty experienced by special education students in their education. In this category, it was emphasised that the biggest obstacle in the education of special education students is the prejudice towards special education students and their being considered inadequate in learning computer science or the teachers' setting the goals for these students lower than they should be. For the other two difficulty categories, it was stated that materials and activities should be designed by taking universal design principles into consideration and the curriculum, including programming tools, should be accessible to all students.

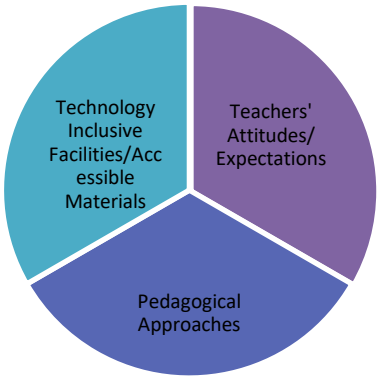

Figure 1.
Difficulties Experienced by Special Education Students in Educational Life (Thompson et al., 2009)

Based on these studies, it is thought that the problems experienced in the education of special education students can be overcome by ensuring that the activities to be organised with the materials to be used in individual education to be given to them are appropriate to their cognitive levels and at a level that will attract their interest and also by ensuring their motivation. In addition, for an effective learning environment, along with the teacher's attitude, supports that eliminate the incompatibility between the personal competence of the special education student and the educator's expectations should also be put into practice (Thompson et al., 2009). The individual experiences a feeling of inadequacy in the absence of the needed supports. For this reason, it is important to determine the support requirements that students will need while coding education is given to special education students.

From this point of view, in this study, the selection of materials and activities to be used in coding education to be given to special education students, the motivation of the student and the determination of the support needs of the student were seen as important variables for the effectiveness of the education.

Among special education student groups, students with mild intellectual disability are a group of students who can gain academic skills with the support and guidance provided during the education process (Snodgrass et al., 2016). Students with mild intellectual disabilities are prone to solving simple and structured problems and learning concepts and have significant potential in gaining new skills. In addition, it is thought that effective coding education to be developed for these students will also provide a basis for students with more severe disabilities. Therefore, it is important to work with students with mild intellectual

disabilities in the study in order to determine effective methods in the coding education process by developing activities and materials suitable for the cognitive levels of these students.

In this context, the effectiveness of materials and activities in the coding education of secondary school students with mild intellectual disability, the effect of these materials and activities on the motivation of the student and the support needs of the student constitute the problem of this research.

Purpose and Importance of the Research

Individuals with intellectual disabilities are diagnosed as having functional deficits in both cognitive and adaptation to the environment in conceptual, social and practical areas, starting before the age of eighteen (MEB, 2018). Although there are different classifications of the subcomponents of computational thinking in the literature, the most frequently emphasised skills can be summarised as sorting, abstract thinking, attention, pattern recognition, algorithmic thinking, generalisation and problem solving (See Figure 2).

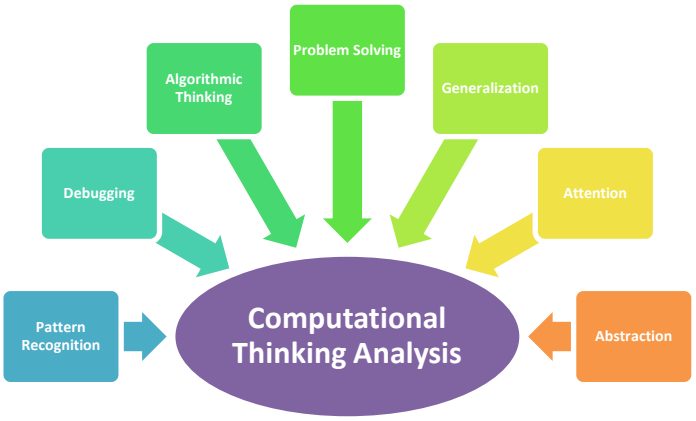

Figure 2.

Sub-Concepts of Computational Thinking

Some studies suggest that the sub-concepts of problem solving, algorithmic thinking, decomposition, generalisation, abstraction and debugging are directly related to coding education given at the K-12 level (Grover & Pea, 2013; Wing, 2006; Yadav et al., 2016). Individuals with intellectual disabilities have problems with skills such as problem solving, reasoning, generalisation, algorithmic thinking, attention, abstract thinking, etc. (See Figure 3), which can be developed by acquiring computational thinking skills in learning processes (MEB, 2021).

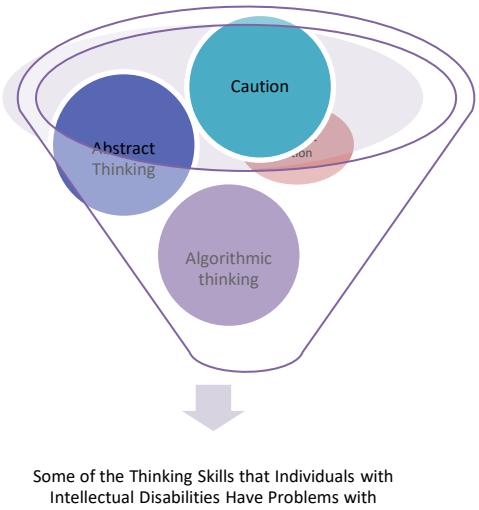

Figure 3.

Some of the Thinking Skills that Individuals with Intellectual Disabilities Have Problems with (MEB, 2021)

For this reason, it is thought that the inclusion of computational thinking skill training, which is one of the high-level thinking skills, in the learning processes of these students will be effective in developing their thinking skills. In addition, Assainova et al. (2018) stated that developing computational thinking skills in students with intellectual disabilities enables them to quickly adapt to the modern world, identify problems and produce complex solutions.

However, there are also studies showing that students with special needs can develop computational thinking skills when they are provided with appropriate support and environment (Lander & Israel, 2016; Stefik & Lander, 2015). As coding and computational thinking are more integrated into the curriculum of students with special needs, information technology teachers and special education teachers need to know which materials to use and how to provide instructional supports to ensure students' motivation and participation during coding education for students with special needs.

In addition, according to Stake (1975), the effectiveness of an instruction can be determined not only by whether its objectives are achieved or not, but also by the evaluations made by the stakeholders. In this context, in this study, practitioner observations and student opinions were included.

In the light of this information, the aim of this study is to examine the student reactions to the activities used during the coding education given to a student with mild disability by direct instruction method according to the materials used, motivation and support needs, and to reveal the evaluations of the student and the researcher about the process. In line with this purpose; the problem of the

research is; 'How is the student's performance, motivation and support needs in the implementation of the materials and activities used in coding instruction given to a secondary school student with mild intellectual disability?'. In line with this problem, answers to the following sub-problems will be sought:

In the coding instruction given to a secondary school student with mild intellectual disability

- Which materials and activities stand out?
- What is the effect of the materials and activities used on student motivation?
- What are the support requirements that the student needs?

Methods

Research Model

This study was conducted with a holistic single case design, one of the case study models (Yıldırım & Şimşek, 2013). The holistic single case design is applied when data are collected from a single unit of analysis (individual, institution, a programme, etc.). In the study, single case design was used to examine the effect of the activities used in coding instruction given to a student with mild intellectual disability on the student's performance, motivation and support needs. The study was limited to a student with mild intellectual disability and the coding learning process was considered as a holistic situation.

Participant and Setting

The participant of the study was a 13-year-old female student who was diagnosed with 'mild intellectual disability' in her medical evaluation report. The student attends the sixth grade in the special education class of a public secondary school. She also attends a rehabilitation centre after school and receives four hours of education per week. The student, who does not have any physical disability, can perform large and small muscle skills independently and initiate communication. The student can also greet acquaintances and respond to questions about himself, his immediate surroundings and the events happening around him in accordance with the context. In addition, he/she can determine what the problem is in the difficulties he/she encounters and can determine that the directions of the objects are different. On the other hand, he can understand and fulfil consecutive instructions of at least three words.

The participant student had not received any training on coding before. He has his own tablet computer at home and can switch on and off information technology devices independently. The student, who can enter the Internet browser and search on these devices, has an interest in information technology devices.

In line with the opinions of special education teachers, the participant was selected because he was interested in information technology devices, had high communication skills and good cognitive performance level. The prerequisite skills of the participant such as 'not having received coding training before, having directional knowledge, being able to read and write, being able to pay attention to the activities for an average of 5 minutes, being able to perform simple operations such as clicking, opening, etc. on information technology devices' were taken into consideration in the evaluation.

Prior to the study, the necessary permissions were obtained from the student, his/her teacher and parents for participation in the study and video filming. In addition, Ethics committee approval was received from Hacettepe University Non-Interventional Clinical Research Ethics Committee (Date: 11.07.2023, Number: 2023-12/44). Before starting the study, the school administration was informed about the subject. The applications related to the study were carried out in the school's information technologies classroom. During the research, paper and pencil activities, coding mat and game with obstacles, code.org block-based coding platform were used. The environment was prepared by the researcher before the application. The whole study was video recorded to determine inter-observer reliability and implementation reliability. Before starting the study, the researcher and the participant were present in the application environment, and the researcher made the evaluation of the prerequisite skills by observing the student in the classroom environment. While presenting the findings, the code name 'Buse' was used instead of the student's real name.

Coding Materials Used in Practice

Paper and pencil activities: These are linear coding activities developed by the practitioner. Two paper and pencil activities were carried out during the study.

Game: It is a game in which the coding mat is laid on the floor and the participant is expected to reach the target without tripping over obstacles (stools). It was used twice during the study.

Code.org: It is a platform that is highly preferred for block-based coding and preferred by the researchers due to the absence of distracting elements for individuals with intellectual disabilities. The lesson planning suitable for the level of the student on the platform was selected by the researchers. The selected sections include only linear programming blocks.

After the materials to be used by the researcher were determined, their suitability was determined by submitting them to the opinion of a field expert, necessary arrangements were made and then they were used in the study.

Data Collection

The data of the study consisted of observation reports, participant opinions, checklist and semi-structured interviews with the teacher. The data obtained from these data sources are listed in Table 1.

Since the research is in the case study model, which is one of the qualitative research methods, the data were collected through semi-structured interviews with the student and unstructured observations made by the researcher in order to collect in-depth information. In order to determine whether the interview questions consisted of questions that the student could answer, the opinions of two experts from the field were consulted, and after the necessary corrections were made in line with the opinions of the experts, it was made ready for application. In line with the expert opinions, all of the questions were taken into consideration. The interview was conducted in the information technologies classroom at the end of the research sessions.

Table 1.

Research Data

Purpose	Data Collection Method	Data Source
Assessing the student's prerequisite skills	Classroom observation Semi-structured interview with a special education teacher	Checklist Audio recording
Obtaining detailed information about the student	Semi-structured interview with a special education teacher	Audio recording
Teaching process	Observation Interview with the student	Video recording Audio recording

The interviews lasted approximately 15 minutes and were based on the volunteerism of the participant. During the interviews, voice recordings were taken in line with the participant's knowledge and permission. During the interviews, the researcher asked the questions in a conversational style and did not give directions about the answers given in order to maintain objectivity. The teaching sessions were videotaped in order to ensure the validity and reliability of the data, to observe the student's verbal as well as non-verbal behaviours, and to have the opportunity to monitor the data in detail. In addition, observation notes were kept by the researcher during the sessions. Each session lasted approximately 10 minutes. While the observation notes were reported by the researcher, the session videos were also used.

Researchers

This research was conducted by two researchers. The role of the first author consisted of instructional planning, observing the implementation, and conducting the research. The role of the second author was instructional planning, planning and providing the necessary materials for the implementation, implementing the implementation, data collection and analysis, and reporting. In addition, the fact that the implementing researcher is an expert in the field of information technologies has benefited the study in the correct execution of coding instruction. An expert from the field of special education and information technologies provided the control of the measurement tools.

Research Process

The research process was carried out in two stages as pre-implementation and implementation process. Before the implementation, detailed data about the student were obtained (evaluation of prerequisite skills and teacher opinions) and coding instruction was planned; during the implementation process, coding instruction was given (paper-pencil activities, block-based coding activities and coding games). During the implementation, the researcher collected data on student performance, motivation and support needs related to the activities carried out by the researcher. In addition, the student was interviewed about the coding activities after the application.

A total of eight sessions were worked with the participant for two weeks, two sessions on Mondays and Thursdays. Attention was paid to take a break of two lesson hours between the sessions. Each session lasted approximately ten minutes. The researcher worked one-to-one with the participant. It was observed that the participant was very eager and enthusiastic before the coding instruction started. In the first session, a video about the fairy tales to be used in the activity was shown for the introduction, and then the coding activity prepared on paper was introduced (two sessions). On the second day, coding was taught by creating obstacles with stools through repetitive dance movements and coding mat (two sessions). In the following sessions, block-based coding activities on code.org were included.

Analysing the Data

The interview data were analysed by descriptive analysis. According to Yıldırım and Şimşek (2013), the data obtained in descriptive analysis are summarised and interpreted according to predetermined themes. Direct quotations

were frequently used where necessary. The findings obtained through interview and observation techniques were defined and interpreted. In addition, attention was paid to reporting the data in an easy-to-understand and readable way. Cause-effect relationships were tried to be established between the findings and where necessary, comparisons with different studies were made and discussed.

In qualitative studies, validity means that the measurement tool measures accurately and presents it unbiasedly as it is. In order to increase the internal validity of the study, while developing the interview form, the interview questions were finalised by taking expert opinion as a result of the review of the relevant literature. During the interviews, the participant's views were not interfered with or guided, and information about the real situation was tried to be reflected in the observations. The participant was selected among the volunteers and it was stated that no information about his/her identity would be shared with the participant. In addition, the research process and what was done in this process were explained in detail. While presenting the interview findings, the situation was given with direct quotations. In order to ensure the reliability of the research, another information technologies expert was asked to listen to the audio recording and to code a certain part of the data. For this purpose, the percentage of agreement suggested by Miles and Huberman (1994) [Reliability = Agreement/(Agreement + Disagreement)] was used and as a result of the calculation, it was determined that the percentage of agreement was above 85%.

Results

The findings of this qualitative research are presented under themes created according to the research purpose and research questions. These themes are provided as views and observations related to instructional materials, motivation, and support needs. The findings are explained within the framework of descriptive analysis as suggested by Yıldırım and Şimşek (2013).

Prominent Materials and Activities in Coding Instruction

During coding education, paper-pencil activities, coding with games, and block-based coding activities were presented to the student. It was determined that the student preferred block-based coding activities the most. The views of the student and the researcher on this matter are presented below under relevant subheadings.

Student Views

The participant stated that all the instructional materials used in coding education were fun. The participant's views on this are as follows:

Buse: *"It was really fun. At first, I couldn't tell if we were doing a lesson or playing a game (laughs)."*
Buse: *"I love using the computer. When my teacher first told me (at the beginning of the lesson week), I said I wouldn't like learning with the computer, but I liked this Angry Bird game (block-based coding activity). (See Figure 4) Is this a lesson?"*

Figure 4.
Programming Activity with Angry Bird on the Code.org Platform

When the participant was asked about her opinions on the paper-pencil activity, the game, and the block-based coding activities used during the coding instruction, she stated that she liked block-based coding the most, followed by the paper-pencil activity (See Figure 5), and she liked the game the least. When asked about the reason for this preference, she explained that they usually do coloring, cutting activities, and play board games in class, so she preferred to do activities on the computer.

Figure 5.
Paper-Pencil Activity with Coding Through Stories

Instructor: Which one did you like more? (the paper-pencil storytelling activity or the storytelling game activity).

Buse: This one was better (the paper-pencil storytelling activity)
Teacher: Did you like the stories (paper-pencil activity)?
Buse: Well... (with an expression of slight dissatisfaction)

Researcher's Observation

The student appeared not to perceive activities involving

computer use as actual lessons. This seems to stem from her previous learning experiences. For example, there is no course specifically focused on information technologies in the special education middle school curriculum. Additionally, students may lack an understanding of how lessons are conducted using information technology devices (such as computers, tablets, VR goggles, etc.). Moreover, their parents may restrict their use of devices like tablets and phones at home, leading them to develop the belief that these technologies are only harmful.

Buse: I have a phone, teacher, but when school started, my mom banned it. I'll use it during the summer.
Buse: I love using the computer, but I don't think I'll enjoy computer lessons (approaching it with prejudice because she dislikes lessons in general).

Among the activities implemented during coding instruction, it was observed that in the corridor game created with a coding mat and stools (See Figure 6), the participant found it easier to imagine herself as the character and thus had no difficulty selecting the directional blocks. She also selected the blocks more quickly.

Figure 6.
Corridor Game

Additionally, the use of colorful designs in the paper-pencil activities prepared for the participant, as well as the inclusion of characters she liked, increased her engagement in the activities. Observations revealed that the participant wanted to converse about the activities, which facilitated more comfortable communication. It was also noted that the participant confidently answered the questions posed to her and successfully adapted to the learning process by listening attentively.

The Effect of Materials and Activities Used in Coding Instruction on Student Motivation

It was determined that among the materials and activities presented during coding instruction, block-based coding activities had the most significant impact on increasing the student's motivation. The student's and researcher's views on this finding are presented below under relevant subheadings.

Student Views

When the participant was asked which activity or activities she would most like to repeat during coding instruction, it was observed that she chose block-based coding. The student's related statements are as follows:

Buse: *"I think we should always do this in front of the computer from now on, it's so much fun..."*
Buse: *"I love playing games on the computer, we're always doing photocopies and coloring in class anyway."*

Researcher's Observations

It was observed that the participant was very excited to start coding instruction. Observations indicated that Buse also focused on the activities, responded to the instructor's questions, and tried to complete the coding activities while murmuring to herself during independent activities. The student did not abandon any activity, instead focusing on the problem at hand and attempting to find a solution. Moreover, it was noted that before the sessions began, Buse expected verbal explanations about the activity to be conducted. When no information was given about the activities for that session, she became anxious and asked the instructor what they would be doing that day.

Although all of the activities attracted the participant's interest, it was observed that the computer-based coding activities were the ones that most motivated her. The participant expressed a desire to continue block-based coding activities. Despite her short attention span, she followed the character's movements based on her commands with great satisfaction. Some of Buse's reactions to this situation are as follows:

Buse: *"Can I continue with this a little longer?"* (Ice Age block-based coding activity)
Buse: *"Is the lesson over already? That was quick!"* (Code.org activities)

In coding activities, the participant was motivated to learn and paid close attention to each activity. The use of a computer during the lessons captured the participant's attention and led to more active participation. It was observed that block-based coding provided more motivation compared to coding with games or paper-pencil activities, and the participant wanted to use block-based coding as a reward during other activities. Some of the participant's reactions to this situation are as follows:

Buse: *"When are we going to use the computer?"*
Buse: *"After I finish this, can I play Angry Bird (block-based coding)?"*
Buse: *"I didn't even notice when the lesson ended, I wish we could do all lessons like this."*
Buse: *"This is really fun..."*

Student Support Needs in Coding Instruction

It was determined that during coding instruction, the student needed support in areas such as receiving approval, basic information technology proficiency, and concretization. The student's and researcher's views on this finding are presented below under relevant subheadings.

Student Views

When asked what she struggled with the most while using the computer, it was understood that Buse had difficulty logging into the Code.org website. Her reactions to this are as follows:

Buse: *"...when I got home, I immediately opened my tablet and wanted to play the game we played, but I couldn't log in."*

Buse: *"...I didn't like the smiley face coloring sheet. It takes too long to read, and coloring takes forever..."*

Researcher's Observations

As required by the individual education program implemented in her special education class, it was observed that Buse needed support to meet her educational needs. Although she was confident in the activities she completed, there were times when she looked up, waiting for approval from the researcher. This caused issues during the implementation of independent activities in the first session. However, in subsequent computer-based sessions, the participant pressed the finish button without needing the researcher's approval after completing the algorithm independently and had the program check whether her algorithm was correct. In the first session, she expected the researcher to perform basic tasks requiring information technology proficiency, such as turning on the computer and connecting to the internet browser. However, in later sessions, she independently performed tasks such as turning on the computer and connecting to the internet.

Nevertheless, despite the use of picture passwords for kindergarten and primary school students, the Code.org site requires a username and password for login. The student consistently needed support with this. The Code.org platform was chosen by the researchers due to the simplicity and clarity of its block-based coding interface. However, it was found that the login interface was confusing for the participant. The participant was unable to find the login section (located at the top right corner) during the sessions (See Figure 7). The other colorful sections on the page distracted her, and she chatted about them. In other words, it was determined that she needed support for logging into the system.

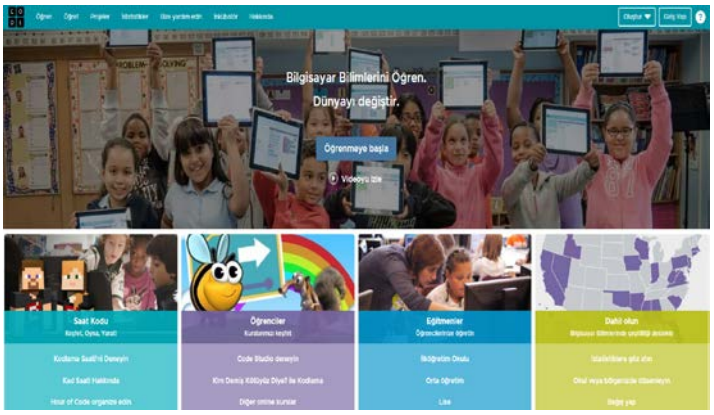

Figure 7.
Code.org Login Page Interface

Additionally, information technology devices or internet connections sometimes encounter technical issues, which can lead to time loss during lessons. Although the participant did not feel the need for help while using the computer during activities, she panicked and did not touch anything when the internet connection was lost, waiting for the instructor to assist her. The participant openly expressed her need for help when necessary. In short, the participant needed to be supported and encouraged by the researcher throughout the application process regarding the use of information technology devices. Some of the participant's reactions to this situation are as follows:

Buse: "The connection is lost, teacher."

Buse: "Can I turn on the computer today?"

Buse: "I have a tablet at home; I can use this too. I can do it."

During these processes, a self-observation chart was prepared to assist the student in remembering the steps of algorithmic thinking during the sessions, using modeling and guided practices. However, it was observed that the student struggled to read this support material, and coloring the smiley face symbols took a long time, leading to boredom and reluctance to use it. A statement reflecting this situation is as follows:

Buse: "...don't give me this paper; I don't need it. Coloring takes too long."

The participant was observed to be more successful in placing herself in the character's position during game activities. It was noted that she needed more concretization in activities on paper. During these activities, the researcher helped the participant to determine the direction in which the character would turn by using either a toy or the participant's own body to provide concretization (See Figure 8).

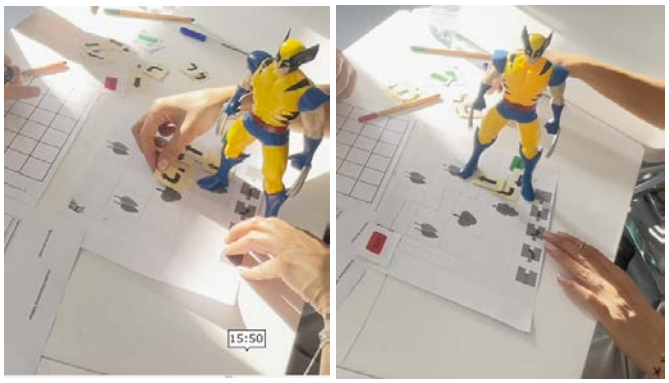

Figure 8.
Concretization Support

Conclusion, Discussion and Recommendations

This study concluded that a student with mild intellectual disabilities reported positive views regarding the coding education provided and actively participated in the sessions. Additionally, it was found that block-based coding materials should be emphasized in coding education for special needs students. In this context, if paper-pencil activities are to be used, preparing them with solid materials will enhance the student's ability to concretize. The materials used should also be designed with more vibrant colors to capture the student's interest.

When examining the student's performance based on the materials used in the coding education provided to the student with mild intellectual disabilities, it was observed that the student was most motivated by block-based coding activities, followed by paper-pencil and game activities.

Finally, this study identified individual supports that could be used in teaching coding to middle school students with mild intellectual disabilities. The participant needed validation from the instructor and support during the game and paper-pencil activities. However, during the block-based coding activity on the Code.org platform, she did not require validation or support. On the other hand, the participant needed help logging into the Code.org site. Therefore, it is essential to ensure that the coding environment selected in research involving special needs students is simple and that the login interface is not complex. Additionally, it was found that the self-observation chart created to help the student remember the steps of algorithmic thinking was not suitable for the special needs student. For future research to effectively serve its purpose, it is suggested that the sentences be shortened, the font size increased, and that the participant be allowed to place marks in her desired color instead of coloring smiley face symbols. In this direction, it can be said that further research is needed on these supports that can help assist special needs students during coding instruction.

In this study, the participant needed support for concretization, verbal expression of the activities before each session, and assistance accessing the block-based coding platform to ensure her active participation in coding activities. While two of these supports are not specifically related to coding, it is essential to conduct single-subject research to investigate the impact of these individual supports on learning. Providing excessive support when assisting a special needs student can lead to learned helplessness in the individual (Causton-Theoharis, 2009; Giangreco et al., 2005; Snodgrass et al., 2016; Stoner et al., 2006). Therefore, as applied in this research, support should only be provided at the moment the individual needs it, with the amount of support gradually increased according to the student's needs.

This study focused on only one student. Therefore, the results cannot be generalized to other contexts. Repeating this study will further support whether the results can be generalized among students and contexts. It is observed that there are many different diagnoses in special needs individuals, such as autism spectrum disorder, Down syndrome, and mild intellectual disability. Considering that this study was conducted with only a student classified as having mild intellectual disabilities, further research is needed on how to teach coding to special needs students.

Additionally, it is believed that information technology education should be included in the curriculum for special needs students. In this study, the participant with mild intellectual disabilities was motivated to learn coding with materials and supports tailored to her special needs. In summary, it has been concluded that special needs students require technology-specific supports and motivating activities to achieve success and actively participate in coding education. If these needs are not met, it is believed that special needs students will not be able to participate meaningfully in coding activities. Currently, special needs students are deprived of the technology lesson experiences that students in regular classes receive at the K-12 level. Therefore, it is suggested that individual supports tailored for special needs students should be identified, with the goal of increasing the student's active participation in technology lessons.

Ethics Committee Approval: Ethics committee approval was received from Hacettepe University Non-Interventional Clinical Research Ethics Committee (Date: 11.07.2023, Number: 2023-12/44).
Informed Consent: Written consent was obtained from the student and his/her parents who participated in this study.
Peer-review: Externally peer-reviewed.
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Reflections of Mind Games Used in Primary School Mathematics Lessons on Teaching and Learning Process: A Case Study

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ABSTRACT

This study focused on the opinions of classroom teachers regarding the reflections of mind games used in mathematics lessons on the teaching and learning process. Case study design, which is one of the qualitative research types, was used in the study. The views of 15 classroom teachers, who used mind games in primary school mathematics lessons and received training on mind games were examined. The criterion sampling method was followed to identify the teachers, who would participate the study. The interview and observation forms developed by the researcher were used to collect the data. Content analysis method was used to analyse the data gathered. The content analysis findings presented the participant's opinions in 14 categories grouped around five themes. As a result of the research, it was determined that classroom teachers used brain teasers to improve students' mathematical skills and to increase their motivation and interest in the lesson. In addition, it was determined that classroom teachers frequently used mind games based on reasoning and operation games in mathematics lessons. In addition, it was concluded that mind games used in the process of teaching and learning mathematics contribute to both cognitive development and social and emotional development of students. Finally, it was determined that classroom teachers experienced difficulties arising from teaching, students and school in the mathematics teaching process supported by mind games. For this reason, a mind games activity guide can be prepared by classroom teachers in primary school mathematics lessons.

Keywords: Primary school mathematics lesson, mind games, case study.

Introduction

One of the main academic subjects that provide useful information for day-to-day living and is essential to personal growth is mathematics. However, mathematics is generally considered discouraging for primary and secondary school students (Sun et al., 2021). The same study also revealed that students prefer something other than mathematics because it is difficult to learn, boring, and useless. Additionally, it is also emphasized that students who have problems learning mathematics will be disadvantaged in their career development and professional life (Kiili et al., 2015). Thus, creating and implementing efficient strategies to boost students' enthusiasm for mathematics and advance their understanding of the subject is critical (Pope & Mangram, 2015). This situation will lead researchers, teachers, and policymakers to explore alternative teaching approaches, especially game-based learning.

Students are expected to possess advanced cognitive abilities in the twenty-first century, including creative thinking, critical thinking and problem-solving. In this context, higher-order thinking skills should be provided to students to educate them in line with the age requirements. In 2024, the Ministry of National Education reformed the curriculum that considers the K12 essential competencies and will be implemented throughout the country (MoNE, 2024). With the curriculum reform, it was emphasized that traditional teaching methods should be transformed and students' skills such as critical thinking, mathematical reasoning, cooperation, problem-solving, and communication skills should be developed. It is thought that mind games, which are evaluated within the scope of game-based learning, will support students' high-level thinking skills as they enable learning by doing and active learning practices (Terzi & Küçük-Demİr, 2022). Using game-based instruction, which forms the basis of primary school and is one of the effective teaching strategies for math instruction, in mathematics lessons is an problem that requires investigation. The purpose of this

study is to investigate the opinions of classroom instructors, who are vital to the teaching of mathematics in elementary schools, on the use of mind games in math classes.

Game-Based Learning

An increasing body of research in education shows that people are curious about the possible effects of using games in the classroom on student progress (Qian & Clark, 2016). Games used in elementary school mathematics lessons can make mathematical concepts concrete and associate abstract knowledge with concrete experiences. According to Piaget's theory of cognitive development, games can serve as concrete materials for primary school kids in the concrete operations period. Using games in the teaching and learning process of elementary school mathematics can increase students' participation in lessons and academic achievement (Hwang & Chen, 2022). In addition, games increase student motivation and improve problem-solving and critical thinking skills (Cicchino, 2015; Deng et al., 2020). A learning environment that incorporates knowledge and skills into games and helps students learn through problem-solving, competitiveness, and teamwork while playing games is known as "game-based learning. (Deng et al., 2020; Qian & Clark, 2016). Game-based learning has generally positive contributions to student achievement. However, some educators emphasize that students with insufficient knowledge and low self-efficacy may be anxious while playing games, negatively affecting student learning (Vandercruysse et al., 2013). Furthermore, it is stated that students who do not know about the functioning and use of games may have negative emotions (Yang et al., 2018).

Game-Based Mathematics Teaching

According to studies, children find games entertaining and exciting when studying mathematics through games (Deng et al., 2020). In addition, students stated that they can learn better by feeling challenged in game-based learning and that games provide permanent learning (O'Rourke et al., 2013). Furthermore, it is emphasized that game-based mathematics teaching has a positive effect on students' self-efficacy (Ninaus et al., 2017). In some studies, it is stated that there is a high level of participation in game-based mathematics teaching at the beginning, but when it lasts longer than one semester, participation decreases (Deater-Deckard et al., 2014; Deng et al., 2020). Research also reveals that teachers tend to prefer traditional teaching methods over game-based mathematics instruction (Yong et al., 2016).

While a large body of research has looked at the effects of game-based learning in mathematics classes, less has been done to explore the perspectives, experiences, and difficulties teachers and students have had when using game-based learning (Deng et al., 2020). The acceptance of game-based learning by educators and learners, who are seen as the primary change agents in the classroom, will determine the effectiveness of its implementation. Thus, a key determinant of the viability of this approach is the opinions and experiences that educators and learners have with play-based learning. In this context, it is necessary to determine the experiences, perceptions, and difficulties faced by teachers and students for game-based mathematics teaching in which students actively participate instead of using traditional teacher-centered teaching in primary school mathematics lessons.

It can be stated that educational games play an important role in the process of teaching and learning mathematics. These games can provide a fun and interactive environment for students to acquire knowledge and skills. In this regard, various forms of educational games can be used during teaching and learning. One of the educational game types is mind games. Mind games are specifically designed to develop cognitive skills and can also support higher-order thinking skills such as reasoning, problem-solving, and analytical thinking. By using mind games, educators and parents can make students' learning processes fun and interactive.

Mind Games in Mathematics Teaching

Mind games are defined as games that increase individuals' awareness of their competencies, enable them to produce alternative solutions to their problems, and support their decision-making processes (Durmaz & Can, 2020). Mind games are used in mathematics teaching, thanks to their advantages. As a matter of fact, studies indicate that there is a strong relationship between students' academic achievement and their ability to play mind games (Şahin & Tezci, 2023). This study found that as the time students spent on word puzzles and mind games increased, their math achievement also increased. It was also stated that mind games encourage mathematical thinking and contribute to meaningful learning (Ergül & Erşen, 2023). On the other hand, mind games enable individuals to use and improve their cognitive skills, such as reasoning, problem-solving, memory, attention, and strategy development (Durmaz & Can, 2020).

The use of mind games in mathematics teaching has been found to support students' problem-solving, mathematical reasoning, and spatial thinking skills (Demirel & Karakuş-Yılmaz, 2019; Şahin & Tezci, 2023; Şanlıdağ & Aykaç, 2021). It was also found to support students' higher order thinking

skills (e.g., critical and creative thinking) (Terzi & Küçük Demİr, 2022). Finally, it is stated that mind games increase motivation for mathematics lessons and contribute to the advancement of mathematical skills in the process of teaching and learning mathematics (Cicchino, 2015).

When the studies on the use of mind games in mathematics lessons were examined, it was seen that the studies generally focused on the secondary school level (Demirel & Karakuş-Yılmaz, 2019; Şanlıdağ & Aykaç, 2021; Terzi & Küçük-Demir, 2022). In these studies, the effects of mind games on middle school students' problem solving (Demirel & Karakuş-Yılmaz, 2019), reflective thinking (Şanlıdağ & Aykaç, 2021) and creative thinking (Terzi & Küçük-Demir, 2022) skills were examined. On the other hand, a limited number of studies were found on the use of mind games in primary school mathematics lessons (Şahin & Tezci, 2023). In this study, the effect of mind games on the problem solving skills of primary school students was examined. When the studies conducted are examined, it can be stated that there is a need for studies that examine the reflections of mind games used in primary school mathematics lessons on the teaching and learning process of mathematics and describe the process in detail.

In this study, according to the opinions of classroom teachers, the reasons for the use of mind games used in primary school mathematics lessons, types, subjects used, their reflections on the mathematics teaching and learning process and the difficulties encountered in the process are discussed. With the related questions, the reflections of mind games on primary school mathematics lessons will be described in depth according to the opinions of classroom teachers. This study is expected to be a guide for classroom teachers, researchers and policy makers working in the field. As a matter of fact, teachers' perceptions and experiences about the reflections of mind games on the mathematics teaching and learning process can be used to decide whether mind games can be successfully implemented in primary school mathematics lessons. In addition, determining the types of mind games used by classroom teachers in primary school mathematics lessons and the related subjects may contribute to the effective use of mind games in mathematics lessons.

Purpose of the Study

This study aims to examine the views of classroom teachers on the reflections of mind games used in mathematics lessons on the teaching and learning process. In this context, the following research questions guided the study.

- What are the reasons for classroom teachers' use of mind games in primary school mathematics lessons?
- What are the types of mind games used by classroom teachers in primary school mathematics lessons?
- What are the reflections of mind games used in primary school mathematics lessons on mathematics teaching and learning process?
- Which mathematics topics are associated with the mind games used by classroom teachers in primary school mathematics lessons?
- What are the challenges faced by classroom teachers in the process of teaching and learning mathematics supported by mind games?

Methods

Research Design

This study aims to examine the opinions of classroom teachers about the mind games used in primary school mathematics lessons. For this purpose, the study was conducted with a case study, which is one of the qualitative research designs (Creswell, 2012). In case studies, one or several situations are investigated with a holistic approach and the focus is on how they affect the relevant situation and how they are affected by the relevant situation (Yıldırım & Şimşek, 2016). This study was designed as a case study in order to reveal classroom teachers' experiences, practices, preferences and the effects of the process regarding the mind games they use in primary school mathematics lessons in a holistic way.

Study Group

In case study research, data sources are picked from persons or groups who experience the phenomenon that the study focuses on and can explain or reflect it (Yıldırım & Şimşek, 2016). In this study, the experiences of classroom teachers who use mind games in elementary school mathematics lessons were discussed. Researchers state that the study group in such studies should be between 10-15 people (Creswell, 2012; Yıldırım & Şimşek, 2016). Since the interviews with the participants will take a long time and even consist of several sessions and in-depth data will be collected, it is natural to keep the study group limited. The teachers who will participate in the investigation were chosen using the criterion sampling method. As criteria, the conditions of receiving training on mind games and using mind games in mathematics lessons were taken into consideration. Official permissions were obtained from the Provincial Directorate of National Education to determine the study group. Secondly, preliminary interviews were conducted with classroom teachers to determine whether they met the necessary criteria. The study group consisted of 15 classroom teachers, eight female and seven male, who met the relevant criteria and volunteered. The study group was limited to this number since data saturation was

achieved. While presenting the findings, the code names of the participants were preferred and the initials of the names were used. Demographic information of the participants is presented in Table 1.

Table 1.

Demographic data of the study group

Teacher	Professional experience	Gender	Teaching class	Education level	Mind game experience *
Aliye	14	Female	3rd grade	Undergraduate	IT, SC
Berna	23	Female	3rd grade	Undergraduate	SC
Ceren	9	Female	3rd grade	Undergraduate	MGC
Derya	21	Female	4th grade	Master's degree	MGC, IT
Emrah	16	Male	1st grade	Master's degree	IT
Fatih	5	Male	2nd grade	Undergraduate	SC
Gamze	8	Female	2nd grade	Master's degree	IT, MGC
Halil	6	Male	4th grade	Undergraduate	SC
İlkin	15	Female	3rd grade	Master's degree	IT
Kemal	17	Male	3rd grade	Doctorate	MGC, IT
Leyla	14	Female	4th grade	Undergraduate	SC
Mert	13	Male	4th grade	Master's degree	IT
Nalan	20	Female	2nd grade	Undergraduate	SC
Osman	8	Male	1st grade	Doctorate	IT, SC, MGC
Ömer	7	Male	4th grade	Undergraduate	MGC, IT

** IT: In-Service Training; SC: Selective Course; MGC: Mind Games Course*

Data Collection Tool

Data for this study were acquired through interviews with classroom teachers and lesson observations conducted by the researcher. The interviews were conducted using a semi-structured interview form prepared by the researcher. Semi-structured interviews are an interview technique in which both pre-prepared questions are asked and additional questions are asked to get detailed information about these questions (Patton, 2021). The relevant form was developed by the researcher after reviewing the literature. The draft form consists of seven questions and probes under each question. The draft form was presented to two experts who have studied primary school mathematics education and mathematics teaching with mind games, and their opinions were obtained. In this sense, the experts were asked to evaluate the questions in terms of meaning, form, and appropriateness to the subject and teachers. As a result of the expert evaluations, one question was removed as it did not serve the purpose. In addition, two questions serving the same purpose were combined. Then, the suitability of the interview form in terms of language and expression was evaluated by taking the opinion of an expert in the field of Turkish education. After receiving expert opinion, it was determined that the form was appropriate in terms of language and expression. Before finalizing the form, it was applied to two classroom teachers to check the comprehensibility of the questions. Both teachers stated that the questions were understandable. In the semi-structured interview form, questions such as "how does the use of mind games in mathematics lessons reflect on the mathematics teaching process?" "Which mathematics subjects are associated with mind games?" and "What are the difficulties encountered in using mind games in mathematics lessons?" were included.

In order to confirm the data collected from the interviews, the researcher made observations in mathematics lessons where mind games were used. Observations were made using the observation form prepared by the researcher. The observation form included the questions in the interview form. In this context, the researcher observed the math lessons of two volunteer classroom teachers. A total of eight lessons were observed, four lessons for each teacher.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Bayburt University Ethics Committee (Date: 04.07.2024, Number: E-79126184-299-206392)
- Informed consent has been obtained from the participants.

Data Analysis

Content analysis method was used to analyze the data obtained. In this way, concepts and relationships that will explain the data obtained are reached (Yıldırım & Şimşek, 2016). In content analysis, similar data are brought together within the plan of sure themes and explained by organizing them in a way that the reader can understand (Patton, 2021; Yıldırım & Şimşek, 2016). The content analysis method was preferred in this study because the themes that explain the data obtained by organizing the emerging concepts and relationships in a logical way will be determined. Within the scope of content analysis, the interviews recorded with a voice recorder were first transcribed. Then, the researcher coded the transcribed data. After coding, themes and categories were determined by considering common patterns and structures. The coding and themes were coded by a different researcher who was not in the study, and the agreement rate between the two researchers was calculated.

Validity and Reliability

In qualitative research, certain measures are taken to ensure validity and reliability (Yıldırım & Şimşek, 2016). Accordingly, in order to provide the internal validity in this research, expert views were consulted about the subject of the research and the suggestions of the experts were taken into consideration. Also, data triangulation was provided by utilizing a variety of data collection instruments during the data collection period. To provide external validity, direct quotations expressing the participants' opinions were frequently used in the presentation of results. Again, in order to ensure external validity, the participant group was selected using a criterion sampling method is used in accordance with the aim of the study. In order to ensure internal reliability in this study, the data obtained from the interviews were coded by two expert researchers, and the coding of the two expert researchers was compared. The Miles and Huberman (1994) formula was used to calculate inter-coder reliability, which was 0.94. The agreement rate amongst coders should be at least 0.80 (Miles & Huberman, 1994). In order to ensure external reliability, the researcher kept the raw data to confirm the results.

Results

In this study, the findings were shaped by considering the research questions. In this context, the findings were presented under five themes. These themes are listed as the reasons for using mind games in mathematics lessons, types of mind games used in mathematics lessons, reflections of mind games on mathematics teaching and learning process, mathematics subjects in which mind games are used, difficulties encountered in the mathematics teaching process supported by mind games. The themes and categories are presented in Figure 1.

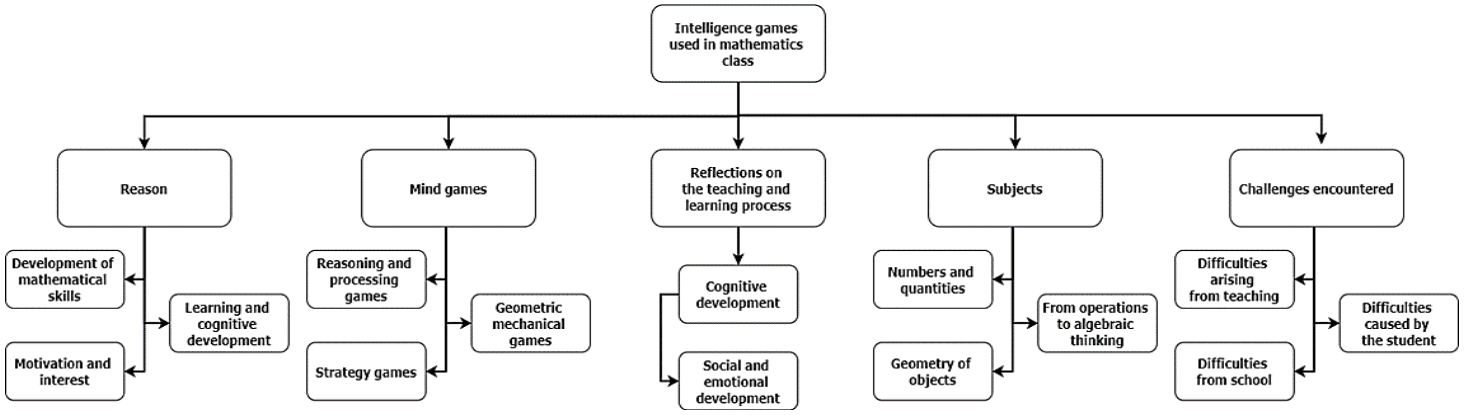

Figure 1.

Distribution of themes and categories included in the research

Reasons for Using Mind Games in Mathematics Lessons

First, the findings regarding the reasons for using mind games in mathematics lessons were discussed. The findings are presented in Table 2 in three categories: development of mathematical skills, learning and cognitive development, and motivation and interest.

Table 2.

Distribution of the Reasons for Using Mind Games in Mathematics Lessons According to Participants

Category	Code	A	B	C	D	E	F	G	H	İ	K	L	M	N	O	Ö	f
Development of mathematical skills	Improving problem solving skills	*		*		*	*				*			*			6
	Improving mathematical calculation skills		*				*		*								3
	Supporting strategy development capabilities						*							*			2
	Discovering alternative solutions							*						*			2
	Improving mathematical thinking skills										*					*	2
	Supporting visual and spatial skills										*						1
Learning and cognitive development	Supporting higher order thinking (reasoning, critical thinking, etc.) skills	*			*	*	*				*		*	*	*		8
	To ensure permanent learning		*							*					*		3
	Teaching geometric shapes		*														1
	Concrete concepts			*													1
	Individualizing learning				*												1
Motivation and interest	Making math class fun		*	*	*	*			*	*	*	*				*	9
	To increase their motivation for mathematics lessons			*	*				*	*			*		*	*	7
	Take attention			*		*			*	*			*				5
	Reinforcing mathematical knowledge							*					*				2

An analysis of Table 2 reveals that the following results are obtained reasons for classroom teachers' use of mind games in mathematics lessons are classified into three categories. In this context, it was observed that classroom teachers used mind games in mathematics lessons to improve mathematical skills, ensure learning and cognitive development, and increase motivation and interest. In the category of developing mathematical skills, it was seen that the most commonly expressed reasons by classroom teachers were to improve students' problem-solving skills (f=6) and mathematical operation skills (f=3). Mind games can support students' problem-solving skills as they provide the opportunity to apply logical thinking and problem-solving strategies. In the category of learning and cognitive development regarding the reasons for using mind games in mathematics lessons, it was seen that the most commonly expressed reasons by classroom teachers were to support students' high-level thinking skills (f=8) and to provide permanent learning (f=3). In the category of motivation and interest in the reasons for using mind games in mathematics lessons, classroom teachers expressed the codes of making mathematics lessons fun (f=9), increasing students' motivation for mathematics lessons (f=7), and attracting attention (f=5) as reasons for using mind games in mathematics lessons. The observation report that supports these findings is as follows: "The teacher used the Qbitz mind game to attract student's attention and increase their motivation while explaining geometric patterns. It was observed that students were interested in the brain teaser (GT: 27.05.2024; İlkin)". Sample teacher opinions on the reasons for using mind games in mathematics lessons are presented below.

Kemal: I use them to develop children's problem-solving and reasoning skills, to make them think fast, to develop visual and mathematical mind, and to make learning fun.

Nalan: As someone who knows that mind games contribute to students in terms of reasoning, problem-solving, and analytical thinking, I definitely include them in mathematics lessons...

Ilkin: I use mind games to make mathematics more fun and enjoyable, to attract students' attention, to make them love mathematics, and to improve students' math skills.

Osman: In math lessons supported by mind games, students learn by having fun, and this increases their motivation for math lessons.

Types of Mind Games Used in Mathematics Class

Secondly, findings regarding the types of mind games used by classroom teachers in primary school mathematics classes are presented. The findings are presented in Table 3 in three categories: reasoning and operation games, geometric mechanics games, and strategy games.

Table 3.

Distribution of the types of mind games used in primary school mathematics classes according to participants

Category	Code	A	B	C	D	E	F	G	H	İ	K	L	M	N	O	Ö	f
Reasoning and processing games	Sudoku	*			*	*	*	*			*	*		*	*	*	10
	Apartments	*					*				*				*		4
	Kakuro			*			*										2
	Process square			*			*			*							3
	Trading games				*						*					*	3
	Kendoku			*	*		*										3
	Bump						*					*					2
	Logic puzzles			*		*											2
	Other (Kenken, mind cards, ABC binding)			*	*									*			3
Geometric-mechanical games	Tangram	*	*		*						*			*	*	*	7
	Qbitz		*					*									2
	Color blocks							*				*					2
	Equilibrio									*							1
	Math puzzles				*												1
Strategy games	Mangala		*			*			*				*				4
	Checkers				*						*						2
	Chess												*				1

When Table 3 is analyzed, it can be stated that classroom teachers used different types of mind games in mathematics lessons. The mind games used by the teachers were categorized under three headings. It was observed that classroom teachers frequently used reasoning and operation games (f=32). It can be stated that reasoning and operation games are frequently applied by different teachers. Based on this situation, it can be said that teachers tend to prefer widely known (for example, sudoku, tangram, Mangala, etc.) mind games. In the category of argument and operation games, it was checked that teachers generally used sudoku (f=10) in mathematics lessons. In addition, it can be stated that they also prefer mind games such as apartments (f=4), kakuro (f=2), and operation squares (f=2). In the category of geometric-mechanical games, it was observed that classroom teachers generally used tangram (f=7) in mathematics lessons. It can also be stated that they preferred mind games such as Qbitz (f=2) and colored blocks (f=2). In the category of strategy games, it was observed that classroom teachers generally used mind games such as Mangala (f=4) and checkers (f=2) in mathematics lessons. In different lesson observations, it was observed that classroom teachers played kokuro, kendoku, tangram, and mangala. Sample teacher views on the types of mind games used in mathematics lessons are given below.

Fatih: Mind games are played with certain steps and strategies. With this logic, students learn to use strategies and step-by-step operations in mathematics lessons. I use sudoku and its derivatives, kakuro, kenken, and Apartman mind games, in mathematics lessons.

Leyla: Finding solutions and recognizing clues are the most important factors that contribute to math lessons. Sudoku, linking letters, and tangrams provide this.

Aliye: I use tangram because it supports math subjects.

Gamze: I use Qbitz and Sudoku because they require thinking about different possibilities. The connection with mathematics allows you to reach the solution quickly and, at the same time, develop different solutions.

Halil: I use mangala because I think it contributes to faster processing...

Mind Games: Reflections on the Math Teaching and Learning Experience

Thirdly, the reflections of the mind games used by classroom teachers in mathematics lessons on the mathematics teaching and learning experience were discussed. The reflections of mind games on the mathematics teaching and learning experience are categorized under two headings: Cognitive development and social and emotional development. The results acquired in this context are presented in Table 4.

Table 4.

Participants' views on the reflections of mind games on mathematics teaching and learning

Category	Code	A	B	C	D	E	F	G	H	İ	K	L	M	N	O	Ö	f
Cognitive development	Contributes to meaningful and permanent learning	*	*	*	*		*	*	*	*	*				*	*	11
	It enables them to produce alternative solutions to problems		*					*	*	*	*	*	*	*	*	*	11
	Supports higher-level thinking skills	*	*		*	*	*		*		*		*	*			9
	Improves students' problem-solving skills		*	*	*	*			*	*	*		*	*			9
	Allows abstract concepts to be concretized			*	*	*						*		*			5
	Allows students to experience a sense of success		*	*	*								*				4
	Supports students' decision-making skills		*					*		*			*				4
	Makes it easier to learn mathematical concepts and relate them to daily life	*		*	*								*				4
	Provides benefits in measurement and evaluation			*					*				*				3
Social and emotional development	It positively affects the attitude towards mathematics class.		*	*	*	*	*		*	*	*		*	*	*	*	12
	Increases motivation for math class	*	*	*	*	*	*		*	*			*		*		10
	Contributes to students' social skills (self-confidence, etc.)		*	*	*		*	*	*	*			*			*	9
	Makes lessons fun		*	*	*		*				*						5
	Supports communication skills		*					*				*	*				4
	Supports collaboration and teamwork				*	*	*										3

According to the views of classroom teachers, the reflections of mind games on the mathematics teaching and learning process are generally positive. In the cognitive development category, according to the opinions of classroom teachers, it was determined that the mind games used in the mathematics teaching and learning process contribute to meaningful and permanent learning (f=11) and enable students to produce alternative solutions to problems (f=11). In addition, it was stated by the classroom teachers that the mind games used in mathematics lessons support students' higher-order thinking (f=9) and problem-solving skills (f=9). The observation report expressed by the researcher during the observation supports the related findings: "The tangram mind game used by the classroom teacher while teaching the subject of length measurement contributed to the students' development of alternative solutions to problems. In addition, the teacher used the tangram mind game to evaluate student learning (GT: 30.05.2024; Fatih)". Sample teacher opinions regarding the codes in the cognitive development category are expressed below.

Kemal: Mind games improve problem-solving skills over time by contributing to multidimensional thinking of problems and finding different and practical solutions.

Ceren: It is effective in developing different solution ways, seeing the solution to the problem quickly, and reaching the solution in a short and quick way.

Derya: Since concepts or names are based on rote memorization, they can be forgotten quickly when a meaningful relationship or connection is not established between them, but giving these concepts through activities or games can shorten the learning time and provide permanent learning.

In the social and emotional development category, according to the opinions of classroom teachers, it was emphasized that the mind games used in the mathematics teaching and learning experience positively affected students' attitudes towards mathematics (f=12) and increased student motivation for mathematics (f=10). Possible reasons for this may be that students experience a sense of achievement during the game and learn by playing. Furthermore, classroom teachers also stated that mind games used in mathematics lessons support students' social skills (f=9). Playing mind games in groups can support students' social skills. During the lesson observations, it was observed that the mind games used in mathematics lessons made the lessons fun: "It was observed that the colored blocks used by the teacher while teaching geometric shapes made the lesson fun for the students. In fact, it was determined that students learned by having fun and exhibited more enthusiastic behaviors (GT: 28.05.2024; İlkin)". Sample teacher opinions regarding the codes in the social and emotional development category are given below.

Emrah: ...It can be stated to have a good effect on students' attitudes toward mathematical lessons. At least the lesson becomes a fun lesson instead of a fearful

dream.

İlkin: Students are more enthusiastic in games, and a student who is timid when solving a normal math problem can act more willingly and confidently.

Gamze: Being successful increases an individual's self-confidence. To succeed also means to be able to do, and what is done is liked and liked to be done. This means that we can make students love mathematics and increase their success in mathematics through games and fun.

Mathematics Topics Using Mind Games

Fourthly, mathematics topics in which mind games were used were discussed. The mathematics topics in which classroom teachers used mind games were presented in three categories: numbers and quantities, operations to algebraic thinking, and geometry of objects. The results achieved in this context are presented in Table 5.

Table 5.

Distribution of mathematics subjects in which mind games are used according to the participants

Category	Code	A	B	C	D	E	F	G	H	İ	K	L	M	N	O	Ö	f
Numbers and quantities	Numbers	*		*	*		*				*					*	6
	Patterns		*	*	*			*						*			5
	Rhythmic counting											*	*				2
	Fractions						*	*									2
	Odd and even numbers								*			*					2
From operations to algebraic thinking	Problem solving			*	*	*		*			*	*	*	*	*	*	10
	Arithmetic operations	*	*	*	*				*	*	*		*	*	*		10
	Algebra teaching						*	*									2
Geometry of objects	Geometrical shapes	*	*	*	*			*			*						6
	Geometry				*	*			*			*		*	*		6
	Spatial relationships		*	*													2
	Geometric concepts								*				*				2
	Symmetry								*			*					2

When Table 5 is examined, it can be stated that mind games are frequently used by classroom teachers in different subjects of mathematics. According to the opinions of classroom teachers, in the category of numbers and quantities, mind games were generally used in teaching numbers (f=6) and patterns (f=5), in the category of operations to algebraic thinking, in problem solving (f=10) and arithmetic operations, and in the category of geometry of objects, in teaching geometric shapes (f=6). Sample teacher opinions on this subject are presented below.

Leyla: Mind games are associated with all subjects of the mathematics course, gamification of all kinds of problems provides easy learning.

Ömer: Associations are more especially in problem solving subjects.

Challenges Encountered in The Experience of Teaching Mathematics Supported with Mind Games

Fifthly, the difficulties encountered by classroom teachers in the mathematics teaching process supported by mind games were discussed. The difficulties encountered in the mathematics teaching experience were showed in three categories as disabilities arising from teaching, students and school. The results acquired in this context are presented in Table 6.

Table 6.

Distribution of the difficulties encountered in the mathematics teaching process supported with mind games according to the participants

Category	Code	A	B	C	D	E	F	G	H	İ	K	L	M	N	O	Ö	f
Difficulties arising from teaching	Time-consuming to implement			*	*	*	*			*	*	*	*			*	9
	Difficulty in planning the brain teasers used in mathematics lessons	*		*				*									3
	Difficult class domination				*				*		*						3
	Difficulties in evaluation			*	*												2
Difficulties caused by the student	Individual variances mean that mind games do not have the same effect on every pupil		*	*	*						*		*		*	*	7
	Inadequate prior knowledge of students about mind games	*					*				*						3
	Loss of interest due to overuse					*		*									2
Difficulties from school	Inadequate infrastructure (physical and technological)			*	*				*						*		4
	Lack of sufficient number of mind games		*						*					*			3
	The costliness of mind games		*						*					*			3
	Crowded class sizes					*								*			2

When Table 6 is examined, it can be stated that classroom teachers who use brain teasers in mathematics lessons face different disabilities in the mathematics teaching experience. In the category of difficulties arising from teaching, classroom teachers stated that mind games applied in mathematics teaching are time-consuming (f=9). In the category of student-related difficulties, classroom teachers emphasized that mind games applied in the mathematics teaching process do not affect each student in the same way due to individual differences (f=7). In the category of school-related difficulties, classroom teachers stated that schools are inadequate in terms of infrastructure (f=4) and that there are not enough mind games in schools (f=3). In the observations made, it was observed that classroom teachers had difficulty ensuring classroom dominance in mathematics lessons in which brain teasers were used. Sample teacher opinions about the difficulties encountered by classroom teachers in the use of brain teasers in mathematics lessons are presented below.

Emrah: If the class size is crowded, there may be time problems. If it is used too often, students may constantly ask for games and deviate from their purpose. Or it may not attract students' attention because it is used too much.

Berna: When there are not enough brain teasers for each student, it is difficult to reach all students. Since students have different types of mind, the brain teasers we use may not be suitable for every student.

Aliye: Every child in the class needs to have a good grasp of brain teasers and math. It requires special planning.

Conclusion and Discussion

This study, the views of classroom teachers and lesson observations made by the researcher regarding the use of brain teasers in elemantary school mathematics lessons were examined. The findings obtained from the classroom teachers' opinions and lesson observations were discussed in the context of the research questions. In addition, the results obtained in this study supported the literature to a great extent but also revealed original results that would contribute to the literature.

When the findings regarding the reasons for using brain teasers in mathematics lessons were examined, it was found that classroom teachers used brain teasers in mathematics lessons to improve students' problem-solving skills, to support higher-level thinking skills, to make the lesson fun and to increase students' interest in the lesson. This situation indicates that classroom teachers want to benefit from the advantages of brain teasers in primary school mathematics lessons. It can be said that the findings on the reasons for using brain teasers in mathematics lessons support the literature. As a matter of fact, similar findings were expressed in studies on the use of mind games in mathematics lessons (Durmaz & Can, 2020). On the other hand, in studies examining the advantages of mind games, it was appeared that mind games are impactful in developing students' problem-solving and reasoning skills (Şahin & Tezci, 2023; Şanlıdağ & Aykaç, 2021). In addition, thanks to mind games, students can gain high-level thinking skills by developing logic, thought, and

interpretation power (Kula, 2020). Students who play mind games develop skills such as strategic thinking, planning, generating alternative solutions, reasoning, and gaining different perspectives (Çalışkan & Mandacı-Şahin, 2019). In another study examining the impactful of the mind games lesson on student achievement, it was resulted that the problem-solving and reasoning skills of students taking this course improved (Şahin & Tezci, 2023). Finally, studies examining the use of mind games in mathematics lessons concluded that mind games make mathematics lessons fun and increase students' interest in the course (Deng, 2020). Since students learn by having fun, it can be interpreted as an expected situation in which their interest in the lesson increases.

When the findings regarding the types of brain teasers used in mathematics lessons were examined, it was found that classroom teachers generally preferred brain teasers based on reasoning and operation games in mathematics lessons. In addition, it was determined that classroom teachers used commonly known mind games such as sudoku, tangram, and Mangala in mathematics lessons. The fact that these games are easier to associate with mathematics subjects than other mind games can be shown as a reason for this situation. It is a known fact that mind games are effective in teaching mathematics subjects. For example, it was found that students who played the kendoku mind game, which is expressed in reasoning and operation games, were more successful in arithmetic operations, and their algebraic thinking skills improved (Reiter et al., 2014). In a study examining the reflections of mind games on second-grade primary school students, it was found that students had difficulty learning the rules of games such as sudoku and Mangala and playing these games (Kula, 2020). This may be justified by the fact that students have difficulty in learning and playing games that require high-level thinking skills based on reasoning because they are still in the second grade. In this study, it was determined that mind games such as chess and checkers, which are among the strategy games, were rarely used by classroom teachers in the mathematics teaching process. However, in studies examining the types of mind games used in mathematics lessons, it is stated that mind games such as chess, checkers, nine-tone, and Mangala support students' mathematical processes (Erdoğan et al., 2017). On the other hand, it is stated that mind games containing mathematics-oriented strategies have an important potential in teaching mathematical concepts (Erdoğan et al., 2017). However, it was emphasized that this potential can emerge with a well-planned instructional design (Deng et al., 2020). In order for brain teasers to make sense, the teacher's activity design skills and guidance are needed (Erdoğan et al., 2017). In addition, it was stated that mind games with a predominance of intuitive strategy could benefit students who have a prejudice against mathematics and have anxiety about learning mathematics (Erdoğan et al., 2017). It can be stated that the findings obtained about the types of mind games used in mathematics lessons support the literature. In addition, it can be stated that the findings on strategy games contradict the literature. In this context, possible reasons for the contradiction were discussed.

When the findings regarding the reflections of mind games on the mathematics teaching and learning process were examined, it was determined that the mind games used by classroom teachers in mathematics lessons contributed to cognitively meaningful and permanent learning, supported students' higher-level thinking skills, and improved their problem-solving skills. The results of this research are generally similar to the results of studies in the literature. Studies examining the reflections of mind games on the mathematics teaching process have determined that the mathematics teaching process integrated with mind games has a positive effect on students (Can, 2020; Kula, 2020). It is stated that mind games used in mathematics lessons facilitate student learning cognitively and contribute to permanent learning (Ergül & Erşen, 2023). Mathematics teaching supported by mind games appeals to different sensory organs and contributes to students' concretization of abstract concepts and meaningful learning. For example, the study conducted by Ergül and Erşen (2023) revealed that classroom teachers use games to ensure meaningful learning in mathematics lessons. Studies indicate that mathematics teaching enriched with mind games supports students' higher-level thinking skills, such as problem-solving, reasoning, evaluation, analysis, and association (Çalışkan & Mandacı-Şahin, 2019; Kula, 2020). It can be stated that the findings obtained in the cognitive development category support the literature regarding the reflections of mind games on the mathematics teaching and learning process.

In this research, it was determined that the mind games used by classroom teachers in the mathematics lesson positively affected the attitude towards the mathematics lesson in a social and emotional sense, increased the motivation for the mathematics lesson, and contributed to the social skills of the students. In studies examining the effects of using mind games in mathematics lessons on the social-emotional development of students, it has been determined that mind games make lessons fun and increase interest in the lesson (Can, 2020; Ergül & Erşen, 2023; Kula, 2020). Studies have stated that mind games used in mathematics lessons positively affect students' attitudes toward mathematics (Deng et al., 2020). In

addition, it has been determined that mathematics teaching supported by mind games contributes to learning by having fun, and the communication skills of students are supported thanks to the cooperation established (Ergül & Erşen, 2023). It can be stated that mathematics teaching supported by mind games has positive contributions to students both cognitively, socially, and emotionally. However, it is stated that students who have insufficient knowledge about mind games and low self-efficacy are anxious while playing games, and this negatively affects student learning (Vandercruysse et al., 2013). It is also emphasized that students who are not knowledgeable about mind games may have negative feelings toward the games (Yang et al., 2018).

When the findings regarding the mathematics subjects in which mind games were used were examined, it was determined that the mind games used in mathematics lessons were widely used by classroom teachers in subjects such as problem-solving, arithmetic operations, geometric shapes, and number teaching. In the study examining the opinions of classroom teachers on the use of mind games in primary school, teachers stated that they mostly benefited from mind games in teaching geometric objects in mathematics lessons (Güneş & Yünkül, 2021). Additionally, in the same study, it was determined that mind games were used in teaching subjects such as arithmetic operations, symmetry, problem-solving, and place and place value. Studies have shown that mind games are effective in teaching mathematics subjects. For example, in a study, it was determined that the kendoku mind game was used to teach algebra and arithmetic operations to students and that students were able to learn these subjects thanks to the mind game (Reiter et al., 2014). Although mind games are used by teachers in mathematics lessons, it can be stated that the studies examining the effect of mind games in teaching mathematics subjects are limited.

When the findings regarding the difficulties encountered in the mathematics teaching process supported by mind games were examined, the classroom teachers emphasized that it was difficult to plan the mathematics teaching process supported by mind games and that mind games were time-consuming in practice. It was also emphasized that the mind games used by classroom teachers in the mathematics teaching process do not affect every student in the same way due to individual differences and that schools are inadequate in terms of infrastructure for the implementation of mind games. When the studies on the use of mind games in the mathematics teaching process are examined, it can be stated that teachers are concerned about similar problems. In the mathematics teaching process supported by mind games, there are time problems due to preparation (Can, 2020), lesson time is not enough for such activities (Can, 2020), mind games do not have a similar effect for all age groups, and there are difficulties in classroom management (Ergül & Erşen, 2023) and requiring a certain cost (Can, 2020) were emphasized. It can be stated that the basis of the problems arising from the use of mind games in the mathematics teaching process is the teachers' knowledge and experience of mind games. As a matter of fact, it is known that teachers who are trained and have experience in using mind games in the mathematics teaching process encounter fewer difficulties in the process (Can, 2020; Kula, 2020).

Limitations and Directions for Future Research

The results of the research showed that the mind games used in mathematics lessons contributed to both the cognitive, social, and emotional development of primary school students. For this reason, it may be recommended that mind games associated with mathematics subjects be identified, which can be used by classroom teachers in primary school mathematics lessons and to support mathematics learning environments with mind games. In this regard, a mind games activity guide can be prepared for classroom teachers by researchers and the Ministry of Education.

In the research, it was determined that classroom teachers experienced various difficulties due to the application of mind games in primary school mathematics lessons. This may indicate that classroom teachers lack knowledge and experience in mind games. In this context, theoretical and applied elective courses on the use of mind games in mathematics lessons can be opened in education faculties for prospective classroom teachers. At the same time, practical and long-term in-service training can be given to classroom teachers on enriching mathematics lessons with mind games.

In this research, it was determined that mind games such as chess and checkers, which are among the strategy games, were rarely used by classroom teachers in the mathematics teaching process. Considering that strategy games such as chess and checkers support students' mathematical processes, in-service training can be given to classroom teachers on these games.

This research has some limitations. The first of these limitations is related to the method. Since this research was designed using the case study method, only qualitative data was analyzed. Future research on the use of mind games in teaching mathematics can contribute to this issue by

supporting it with quantitative data and explaining it with experimental processes. In this context, long-term longitudinal studies can be conducted examining the effects of mind games on the mathematical skills of primary school students. In addition, the cognitive, social, and emotional development of students who have experienced mind games can be examined in detail and in-depth. Another limitation is related to data collection tools. The data of the research was collected through interviews and observation and is limited to these data collection tools only. In research on this subject, researchers can reach more detailed findings by diversifying the data.

Although this research has some limitations, it contributes to the existing mathematics education literature by providing a detailed description of the use of mind games in mathematics teaching. Classroom teachers and mathematics educators should take into account that mind games used in mathematics teaching contribute to students' meaningful and permanent learning, support problem-solving skills, and positively affect the attitude toward mathematics lessons. Therefore, supporting the mathematics teaching and learning process with mind games by classroom teachers can support student learning.

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Informed Consent: In this study, written informed consent was obtained from the classroom teachers in the study group.
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Author Contributions: The whole process was followed by the researcher.
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Exploring the Persistent Impact of Online Education on Graduation Grade Point Average: A Case Study in Industrial Engineering

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ABSTRACT

Due to the global impact of the Covid-19 pandemic, educational institutions worldwide resorted to remote/online learning for uncertain periods. Researchers have extensively monitored the effects of Covid-19 on education at various levels. While several studies in the literature have indicated a positive numerical impact of online education on course success, others have revealed that students, despite achieving high grades, may experience dissatisfaction with online education for various reasons such as lack of motivation, communication challenges, and limited opportunities to engage with course content. This study delves into the long-term outcomes of online education by examining students' Grade Point Averages (GPAs). Specifically, the research assesses the academic performance of first, second, and fourth-grade students enrolled in industrial engineering, considering selected courses, matriculation scores, and graduation averages across both online and face-to-face learning periods. Descriptive statistics, analysis of variance to explore group relationships, and Pearson correlation to analyze parameter relationships were employed in the study. Upon scrutinizing the study results, it was observed that the GPAs exhibited a correlation with the matriculation score but did not show a significant relationship with courses learned through online education.

Keywords: Online education, face 2 face education, long term affect of online education.

Introduction

The Covid-19 pandemic brought about significant changes across various aspects of human life, from manufacturing to education. In the manufacturing sector, there were disruptions, leading production enterprises to adapt by operating in more shifts with reduced personnel in each shift. The health sector prioritized addressing the Covid-19 epidemic, resulting in the postponement of non-urgent surgeries and outpatient clinic services. The tourism industry experienced a notable slowdown. Globally, online education methods gained widespread preference. In Turkey, online education was implemented for an extended period, spanning one and a half years or three semesters. Additionally, online education was also adopted in Turkey for one semester in response to a major earthquake in Maraş. These changes reflect the adaptive measures taken in response to external challenges, emphasizing the versatility of online education in various circumstances.

The transition to distance education, prompted by the unprecedented challenges posed by the Covid-19 pandemic and earthquakes, has significantly reshaped the landscape of higher education. However, the comprehensive understanding of the effectiveness and impact of this transition on student success, particularly in engineering education, remains a crucial area of investigation. While existing literature provides insights into various aspects of online education, there is a notable gap in understanding its specific implications for disciplines like industrial engineering.

This study aims to address this gap by examining the long-term effects of online education on the academic performance of industrial engineering students. By delving into the nuances of this transition and its implications, the research seeks to elucidate the extent to which online learning models have influenced student success metrics,

particularly Grade Point Averages (GPAs). Through a comprehensive analysis, this study endeavors to provide actionable insights for educational stakeholders to optimize online learning experiences in engineering education. There are three research questions given below for a clearly understanding;

RQ1: What is the impact of the transition to online education on the GPAs of industrial engineering students?
RQ2: How do the academic performance trends differ among different semester students during online and face-to-face learning periods?
RQ3: Are there any significantly relations between matriculation score and course success with GPAs?

By addressing these research questions, this study seeks to contribute to the growing body of knowledge on online education and its implications for engineering disciplines, offering valuable insights for educational practitioners and policymakers alike. For a total of two years and 4 semesters, courses, exams, midterms, projects and laboratory studies were conducted entirely through online education tools. Online and face-to-face education durations are as shown in Figure 1.

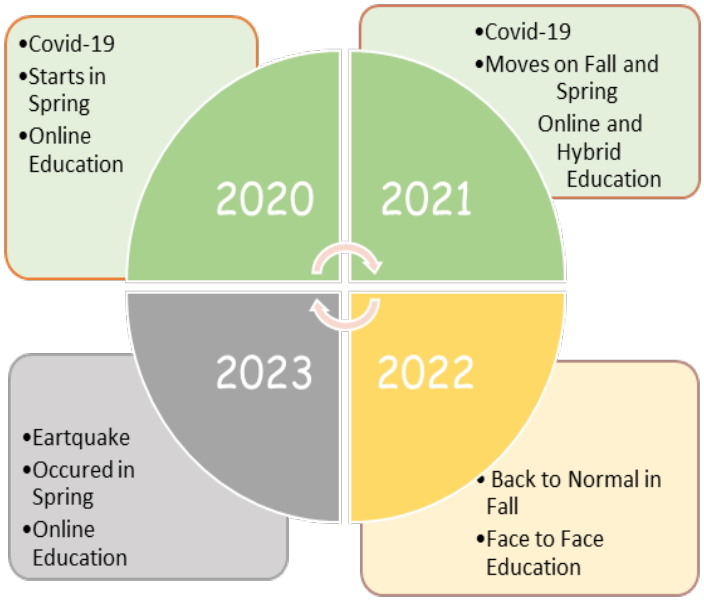

Figure 1.
Online and Face To Face Education For 4 Year

Literature Review

The studies presented in this section consist of studies investigating the effects of distance/online education on students' academic performance.

Studies by Zhou et al. (2021) and Sengupta and Gupta (2021) explored the impact of online education on student academic performance, providing insights into the effectiveness of virtual instruction methods. Another group of studies focused on the impact of the COVID-19 pandemic on online education practices. Alkhalil et al. (2021), García-Alberti et al. (2021), and Martínez-García et al. (2022) investigated the challenges and experiences of remote learning during the pandemic, while Nazempour et al. (2022) assessed the impacts of emergency transitions to remote teaching on students' academic performance. These studies shed light on the adaptations made in response to the crisis and their implications for engineering education.

Díez-Pascual et al. (2023) compared face-to-face and online learning in science and engineering courses during the COVID-19 pandemic. Their study explored the effectiveness of different instructional modalities in promoting student engagement and academic success. Zhang et al. (2023) investigated the effectiveness of synchronous and asynchronous online learning during the COVID-19 pandemic. Their research compared the outcomes of different online learning formats and their impact on student engagement and academic achievement.

A study by Wang et al. (2022) examined the challenges and opportunities for engineering students adapting to online learning during the COVID-19 pandemic. Their research identified strategies for enhancing student engagement and academic success in virtual instructional settings. Another study focused on student preparedness in online engineering education, providing insights into factors influencing student readiness for virtual learning environments and their implications for instructional design (Wang & Jiang, 2022).

Ulum (2022) presented a meta-analysis study examining the effects of online education on academic success. By aggregating and analyzing data from various studies, the research concluded that online education generally has a positive impact on academic performance. However, the extent of this impact varies depending on the type of course, student demographics, and instructional methods used. Interactive and personalized learning tools in online education were identified as critical factors in enhancing academic success.

Nieuwoudt (2020) explored the role of synchronous (real-time) and asynchronous (self-paced) class attendance in predicting academic success in online education. The findings indicated that synchronous class attendance is strongly correlated with higher academic performance, as

it fosters immediate interaction and feedback. However, asynchronous attendance also showed significant benefits, especially for students requiring flexible learning schedules.

A study by Torun (2020) examined the readiness of students for e-learning as a predictor of academic achievement in online distance learning within higher education. The study highlighted that students' technical skills, self-discipline, and motivation are crucial factors influencing their success in an online learning environment. Higher e-learning readiness was associated with better academic performance, emphasizing the need for preparatory training and resources.

Neroni et al. (2019) investigated the impact of different learning strategies on academic performance in distance education. The study identified effective strategies such as time management, self-regulation, and active engagement with course materials. It concluded that students employing a combination of these strategies tend to perform better academically in a distance learning setting.

Another article by Jiao et al. (2022) introduced an AI-enabled prediction model designed to forecast student academic performance in online engineering education. Utilizing machine learning algorithms, the model analyzed various factors such as engagement metrics, assignment scores, and participation rates. The study demonstrated that the AI model could accurately predict academic outcomes, providing valuable insights for educators to support at-risk students.

Bir (2019) compared the academic performance of students enrolled in online engineering courses versus those in traditional classroom settings. The findings revealed that, on average, students in online courses performed comparably to their peers in traditional settings. However, the study noted that the effectiveness of online courses is highly dependent on the quality of the course design and the level of student support provided.

Mamedova et al. (2023) evaluated the impact of various educational platforms on the academic performance of engineering students in an online education context. Their study assessed platforms based on usability, interactivity, and support features, finding that platforms offering robust interactive tools and comprehensive support services significantly enhance students' learning experiences and academic outcomes.

Kanetaki et al. (2021) analyzed engineering students' academic performance in online higher education during the COVID-19 pandemic. The study identified trends and challenges faced by students, including issues related to remote learning environments, access to resources, and mental health. The findings suggested that while many students adapted well to online learning, targeted interventions are necessary to support those who struggled during this period.

Ouyang et al. (2023) explored how integrating artificial intelligence (AI) with learning analytics (LA) can enhance the academic performance of engineering students in online courses. The research highlighted that AI models could predict student performance by analyzing various learning behaviors and providing real-time feedback. This integration helps identify at-risk students and optimize instructional strategies, thereby improving overall learning outcomes.

Meng and Hu (2023) evaluated the relationship between student motivation and academic performance, with a particular focus on the mediating role of online learning behavior. The findings indicated that both intrinsic and extrinsic motivations significantly impact academic performance through active engagement in online learning activities. Enhancing online learning behaviors, such as participation in virtual classrooms and timely submission of assignments, is crucial for maximizing the benefits of blended learning environments.

Two systematic reviews by Chung et al. (2022) and Zekaj (2023) examined various factors influencing academic performance in online higher education settings. Chung et al. (2022) highlighted that student characteristics, including cognitive and psychological factors, significantly impact performance, suggesting that understanding these correlates can help design better support systems. Zekaj (2023) focused on the impact of various online learning strategies, revealing that active engagement, effective time management, and regular participation in online discussions are crucial for academic success.

Finally, studies in the literature have generally assessed academic success through various metrics such as exam grades (Díez-Pascual et al., 2023), project scores (Jiao et al., 2022), presentations, teamwork (Meng & Hu, 2023), and laboratory works. However, the current study diverges from this approach by focusing specifically on the impact of compulsory online education—implemented for approximately two years in departments lacking prior infrastructure for distance learning—on students' GPAs. This study investigates the influence of students' entrance scores and academic performance during the online education period on their overall GPAs.

Methods

In beginning, the number of students enrolled in the department and courses, the number of graduating students, their grades in courses, the averages, standard deviations of each course, minimum and maximum values and the number of registered students are explained with descriptive statistics methods. ANOVA test was used to measure whether there were significant differences between the success of the courses in the distance and face-to-face periods, and the Tukey test was used to measure the success of each course in different periods.

In Tukey's test, letter grouping is used to indicate significant differences between group means after conducting an ANOVA or a similar test. After performing a statistical test such as ANOVA to compare multiple group means, Tukey's test is often employed as a post hoc test to determine which specific group means are significantly different from each other.

The letter grouping system in Tukey's test assigns different letters (e.g., A, B, C) to the group means based on their statistical similarity. Groups that share the same letter are not significantly different from each other at the chosen level of significance (e.g., $\alpha = .05$), while groups with different letters are significantly different. Finally, whether there is a relationship between the final grades, matriculation scores and GPAs of the students used in this study was investigated using Pearson correlation.

An Overview of the Study

This study encompasses a selection of courses within the Industrial Engineering undergraduate program's curriculum, comprising one elective course, "Inventory Planning" and three core courses: "Introduction to Probability," "Cost Accounting" and "Design". All these courses are instructed by a full-time faculty member in the Department of Industrial Engineering.

Table 1.
Guideline About Courses

Lecture Name	Term	Type	Ects	Period	Midterm Exam	2. Midterm Exam	Quiz	Project	Final Exam
Int. to Probability	2	selective	5	14 week	✓		✓		✓
Cost Accounting	3	core	5	14 week	✓				✓
Inventory Planning	8	core	3	14 week	✓	✓	✓		✓
Design	8	core	6	14 week				✓	✓

The entries in the table above correspond to the following categories: "Term" denotes the period during which the course is integrated into the curriculum, "Type" indicates whether the course is elective or core, "ECTS" refers to the European Credit Transfer System, and "Period" represents the duration of the course in weeks per semester. The examination components include the midterm exam, second midterm exam, quiz, project, and final exam, each denoted by checkmarks in Table 1 to signify the types of evaluations conducted for each course.

In the assessment of courses, the final grade at the end of the semester is determined by a combination of factors. Specifically, 50% of the final grade is derived from the final exam, while the remaining 50% is based on midterm exams and other activities. The faculty member responsible for each course determines the relative weight of midterm exams, quizzes, and projects in influencing the overall success grade.

Data Collection

The study's data were sourced from the Atatürk University Student Information System. Among the courses named, “Introduction to Probability” and “Cost Accounting” fall within the core course category and are instructed by a single faculty member during the respective semesters. “Inventory Planning” is an elective course, and students have an alternative option, "Enterprise Resource Planning”. “Design” is classified as a core course, and when offered, it involves the collaboration of 4-6 faculty members simultaneously. These courses (except design) have been taught by a single industrial engineering departmant member for the last 5 years and that is why they were chosen by researcher. Table 2 provides information on the academic year, semester of instruction, and the count of students who registered for and were assessed in each course during the specified periods

Table 2.
Course Periods and Number of Students Evaluated

	2019-2020		2020-2021		2021-2022		2022-2023		
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Total
Int. to Probability		102		99		87		107	395
Cost Acc.	63		119		91		93		366
Inventory P.		31		40		32		47	150
Design		24		25		27		35	111

Descriptive Statistics

In the initial phase of the study, the academic performance of students was scrutinized across four courses during both online and face-to-face education periods. Among the courses considered, "Inventory Planning", "Introduction to Probability" and "Design" are conducted during the spring semester as stipulated by the curriculum. Notably, "Design" is an advanced course aimed at assisting students in analyzing, planning, and designing a project. It is taught by four-six faculty members simultaneously during the same semester. Conversely, the "Cost Accounting" course is scheduled for the fall semester and is instructed by a single faculty member. Figure 2 illustrates the mean final success grades for each course during the periods of the Covid-19 pandemic, face-to-face instruction, and the earthquake occurrence. All statistical analyses in this study were carried out utilizing the Minitab 21 application.

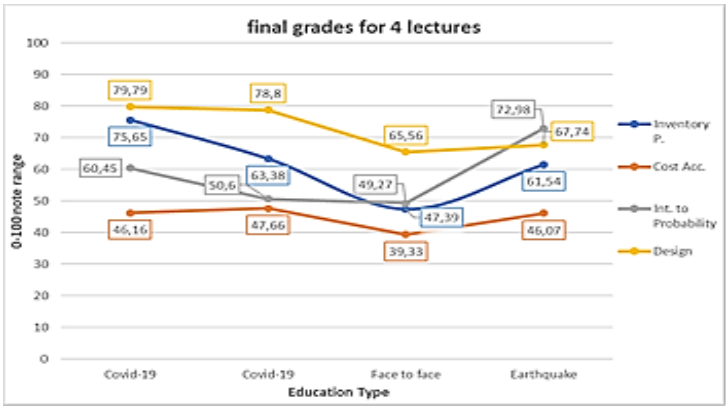

Figure 2.
Final Success Grade Means of Each Course

The x-axis in Figure 2 represents the grade range (0-100) that students can achieve in each course. On the y-axis, the education periods are depicted. The Covid-19 and Earthquake column, spanning four years, signifies the periods of online education, while the face-to-face column represents education conducted in a traditional classroom setting. Upon analyzing the average success rates of each course, it becomes evident that the success grade averages during face-to-face periods are lower compared to the averages of the other three semesters conducted via online education. This observation suggests that the online education system may enhance the success of engineering faculty students.

However, it is important to note that upon reviewing exam papers, it is apparent that the similarity in answers given by students to the same question does not support this assumption. The continuous communication among students during exams and the lack of instantaneous monitoring through a camera contribute to this perception. As a concluding remark regarding Figure 2, the course with the closest average across all four years is the cost accounting course. The inventory planning course, characterized by a high algebraic calculation load, exhibits the highest variability. Additionally, despite being a fall semester course, the cost accounting course's initial average value of 46.16 is lower than the averages of the remotely conducted semesters. Descriptive statistical parameters for each course are detailed in Table 3.

Table 3.
Descriptive Statistical Parameters of The Courses

Parameter	N	Mean	St. Dev	Min	Q1	Median	Q3	Max
Inventory P.	150	61.93	17.98	.00	55.00	63.75	73.13	92.50
Cost Acc.	366	45.30	23.06	.00	33.00	49.50	62.00	98.50
Int. to Probability	395	60.89	27.05	.00	48.50	67.50	81.00	100.00
Design	111	72.40	17.86	11.00	55.00	75.00	85.00	95.00

Table 3 provides the following statistical measures for the success grades achieved over four years: sample size (N), mean, standard deviation, minimum (Min), maximum (Max), and quartiles (Q1, Q3). Notably, Q1 represents the 25th percentile, and Q3 signifies the 75th percentile.

According to the table, the course with the largest number of students is "Introduction to Probability," with 395 students, while the course with the fewest students is "Design," with 111 students. Additionally, the course with the highest average success grade is "Design," boasting a mean of 72.40, whereas the course with the lowest average

success grade is "Cost Accounting," with a mean of 45.30. The range of success grades spans from a minimum of 0 to a maximum of 100.

One-Way Anova and Tukey Test

The combination of One-way Analysis of Variance (ANOVA) and the Tukey test serves as a statistical approach for comparing means across multiple groups. One-way ANOVA is utilized when there are three or more groups, aiming to discern whether statistically significant differences exist among the means of these groups. In this study, the academic success of students was analyzed on a semester basis, employing both one-way ANOVA and the Tukey test at a 95% confidence level. The outcomes of these analyses are detailed in Table 4.

Table 4.

The Results of ANOVA and Tukey Test

Analysis of Variance-*Inventory Planning*					Tukey Method at 95% Confidence Level					
Terms	N	Mean	StDev	*p*	Terms	N	Mean	Grouping		
Covid 19-20	31	75.65	11.01	.000	Covid 19-20	31	75.65	A		
Covid 19-21	40	63.375	5.563		Covid 19-21	40	63.375		B	
Face to face	32	47.39	23.71		Earthquake	47	61.54		B	
Earthquake	47	61.54	16.95		Face to face	32	47.39			C
Analysis of Variance-*Cost Accounting*					Tukey Method at 95% Confidence Level					
Terms	N	Mean	StDev	*p*	Terms	N	Mean	Grouping		
Covid 19-20	63	46.16	21.28	.039	Covid 19-20	119	47.66	A		
Covid 19-21	119	47.66	18.6		Earthquake	93	47.55	A	B	
Face to face	91	39.33	28.26		Covid 19-21	63	46.16	A	B	
Earthquake	93	47.55	23.07		Face to face	91	39.33		B	
Analysis of Variance-*Introduction to Probability*					Tukey Method at 95% Confidence Level					
Terms	N	Mean	StDev	*p*	Terms	N	Mean	Grouping		
Covid 19-20	102	60.45	26.74	.000	Earthquake	107	78.44	A		
Covid 19-21	99	50.6	26.11		Covid 19-20	102	60.45		B	
Face to face	87	49.38	25.79		Covid 19-21	99	50.6			C
Earthquake	107	78.44	21.23		Face to face	87	49.38			C
Analysis of Variance-*Design*					Tukey Method at 95% Confidence Level					
Terms	N	Mean	StDev	*p*	Terms	N	Mean	Grouping		
Covid 19-20	24	80.42	9.55	.002	Covid 19-20	24	80.42	A		
Covid 19-21	25	78.6	15.38		Covid 19-21	25	78.6	A	B	
Face to face	27	65.56	12.89		Earthquake	35	67.74		B	C
Earthquake	35	67.74	23.3		Face to face	27	65.56			C

Upon examination of the results in Table 5, it was observed that significant differences existed among the inter-semester groups for the Inventory Planning, Introduction to Probability, and Design and Cost Accounting courses ($p < .05$). RQ2 can be answered obviouslu with a focus on ANOVA results. It is seen as a result of the variance analysis that the grade success averages of the courses increased during the periods when the education was provided online.

Further insights from the Tukey test results, presented on the right side of the table, revealed significant differences among the Inventory Planning course groups. Specifically, the success rate of the Inventory Planning course during the face-to-face period was significantly different from its success rates during other semesters. Significant differences were also identified among the groups for the Introduction to Probability course. Notably, the mean during the earthquake period and the first Covid-19 period were found to be significantly different compared to other groups. A similar scenario applied to the success means of the Design course, where the Covid-19 periods were significantly different from other periods. RQ2 has found its own answer. No significant relationship was found between the transition to online education and students' graduation averages.

Figure 3 displays histogram diagrams illustrating the distributions of grade point averages and the frequencies of grade ranges. These visualizations provide additional insights into the overall distribution patterns of student performance.

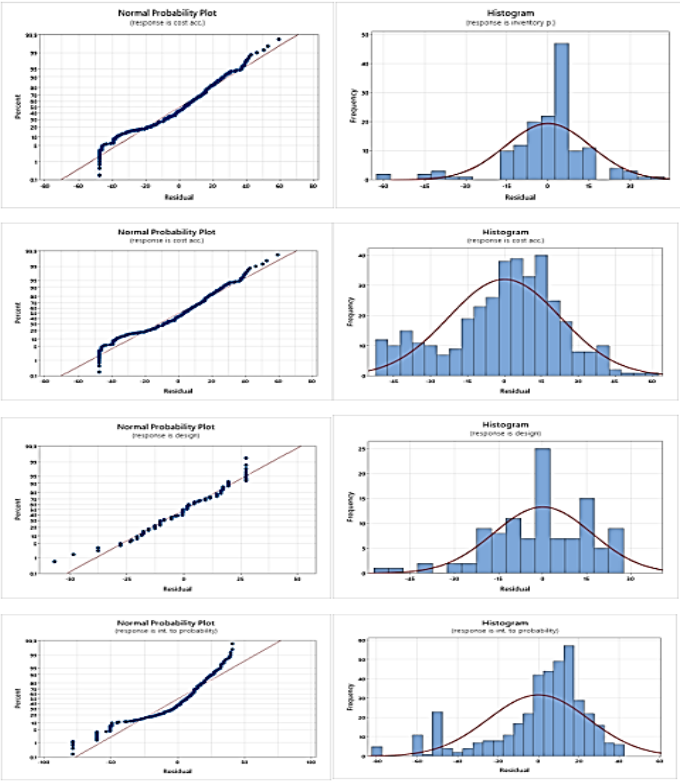

Figure 3.
Distributions and Histogram Charts

It appears that the next step in the study involves examining the Grade Point Averages (GPAs) of students who graduated between 2019 and 2023. Figure 4 illustrates the graph of GPAs across these years. This analysis could provide valuable insights into the academic performance trends of graduating students over this period.

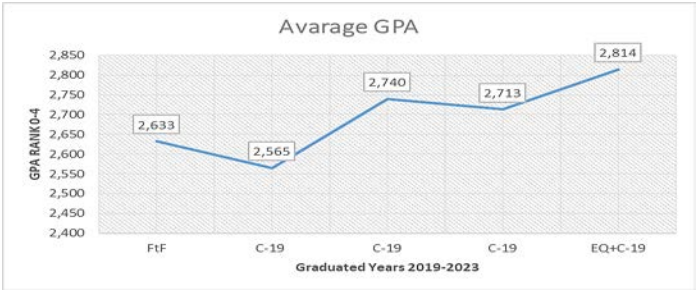

Figure 4.
Average Gpa's by Years

Figure 4 illustrates GPA ranges on the vertical axis, with the horizontal axis representing the education periods of students who graduated between 2019 and 2023. The graduation patterns are as follows: the student who graduated in 2019 completed face-to-face education, those who graduated in 2020, 2021, and 2022 pursued online education courses due to Covid-19, and finally, those who graduated in 2023 completed online education courses due to both Covid-19 and the earthquake. For a more detailed visualization of students' graduation averages, Figure 5 is presented. This graph likely offers a comprehensive view of how GPAs varied across different graduating classes and educational contexts.

Figure 5.
Gps Ranges by Years

To earn graduation from the Faculty of Engineering, a student needs to complete 240 ECTS courses and maintain a minimum GPA of 2.00, with an upper limit of 4.00. Figure 5 illustrates the distribution of students' GPAs by year. The GPA distribution is presented at the bottom of the columns, and the numbers above each column signify the count of students graduating within that GPA range for the respective year. Upon examining Figure 5, it becomes apparent that as the number of semesters in online education increases, the number of students graduating with a higher GPA also increases.

Figure 6 provides an overview of the total number of online and face-to-face courses taken by graduating students per year. Over the course of four years and eight semesters, the total number of courses completed by students amounted to 48.

In 2019, students did not engage in online education courses. However, the landscape changed in 2020 with the advent of Covid-19, prompting students to initiate online courses. The notable increase in the number of courses in 2023 can be attributed to the earthquake that occurred on February 6. Table 5 delves into the distinctions in GPAs across different years, employing Anova and Tukey tests to assess these differences. These statistical analyses likely provide insights into how GPAs vary across different academic years and educational context.

Figure 6.
Courses Taught Online and Face to Face by Years

Table 5.
Anova and Tukey Test for GPA

Total number of courses taught by distance education	Number of terms affected by C-19 and EQ				Analysis of Variance-*Graduation Grade*					Tukey Method at 95% Confidence Level				
					Graduation Year	N	Mean	StDev	*p*	Graduation Year	N	Mean	Grouping	
0					2019	62	2.6327	.34	.000	2023	60	2.8143	A	
6				C-19	2020	60	2.5647	.2539		2021	50	2.74	A	B
18		C-19	C-19	C-19	2021	50	2.74	.2733		2022	63	2.7129	A	B
18		C-19	C-19	C-19	2022	63	2.7129	.2926		2019	62	2.6327		B C
24	EQ	C-19	C-19	C-19	2023	60	2.8143	.3247		2020	60	2.5647		C

In Table 5, the columns provide information on the total number of courses conducted via online education, the periods during which online education was offered along with the reasons (Covid-19, earthquake), the graduation years of students, the count of graduating students in each respective year, and the mean and standard deviation of GPAs. Given that $p < .05$, it is evident that there is a significant difference between the mean GPAs.

On the right side of the table, the outcomes of the Tukey test conducted at the 95% confidence level are presented. According to these results, the GPA means of individuals graduating in 2021, 2022, and 2023 (who completed 18-24 courses through online education) are significantly different from those who graduated in 2019 and 2020 (who completed 0-6 courses through online education). This information suggests a substantial impact of the number of online courses on the GPAs of graduating students.

Pearson Correlation Test

In this section, the associations between the courses under investigation, GPAs, and matriculation scores were explored in pairs. In the Turkish education system, students undergo a central exam, and based on their scores, preferences, and a central assignment algorithm, they are allocated to departments. Student groups were randomly selected during the examination of the correlation between students' matriculation scores in the department and other parameters. Table 6 presents the results of pairwise correlations, shedding light on the relationships between these variables.

Table 6.
Correlations Between Courses, Gpa, and Matriculation Scores

Variables (295 total graduates)	Matriculation Score 200-400	Gpa 2.00-4.00	Inventory P.	Cost Acc.	Int. to Probability	Design
Matriculation Score	1.000					
Gpa	.725	1.000				
Inventory P.	.067	- .163	1.000			
Cost Acc.	.096	- .102	.155	1.000		
Int. to Probability	.385	.161	- .003	.079	1.000	
Design	.061	.026	.096	.019	- .173	1.000

As per Table 6, the total number of graduates between 2019 and 2023 is reported as 259. Upon scrutinizing the bilateral correlations, it becomes evident that the most notable relationship exists between GPA and matriculation score. The substantial correlation coefficient of .725 signifies a positive and robust association between these two variables. For all other pairs, the Pearson correlation values range between $-.173 < p < .385$. This indicates that the relationships in these cases are weak. Thus, the RQ1 has found answer. No significant relationship was found between the transition to online education and GPAs. The correlation coefficients provide insights into the strength and direction of these relationships, and it appears that GPA and matriculation score have the most pronounced and positive correlation among the variables examined.

As a result of the analysis, it was determined that the courses success dosent pair off with GPAs, in other saying there is no significant relationship between courses success and GPAs. But students with higher matriculation scores

graduated with higher GPAs and have a significant relationship each other.

Results

This study examines the academic performance of Engineering Faculty students in both online and face-to-face education periods and assesses the long-term impact of online education on students' GPAs. The ANOVA test, conducted at a 95% confidence level, revealed significant differences in student performance between the two modes of education. This variation is largely attributed to the nature of online exams. Historical data indicates that students who previously failed courses during face-to-face instruction were able to pass these courses with higher scores during the online education period. Further analysis on a course-by-course basis showed an increase in average course success rates and a decrease in the number of students failed.

Another notable finding is that students' GPAs were higher during the online education period compared to previous years, as illustrated in Figures 4 and 5. Figure 5 clearly illustrates the intervals of GPAs during online and face to face periods. Mostly students have increased better GPAs scores in online period. Finally, another finding of the study is that there is a strong positive relationship between matriculation score and GPAs.

Discussion

The transition from formal education to online education in Turkey and the world occurred with the Covid-19 pandemic. As lecturers, we started to provide remote education directly via the internet and camera, without having any online education infrastructure before. The ability to record lecture videos was a positive situation for the quality of online education. However, taking the exams as projects, homeworks or traditionally was one of the biggest handicaps of online education. This study examines the results that occur when the education and exam environment changes (online) while all other variables (lecturer, student and course content) are constant. As such, the quality of online education could not be the main subject of this study.

All four courses discussed in this study were taught by the same lecturer in both face-to-face and online education periods. This situation does not scientifically change the fact that the faculty member can act subjectively. However, since only one lecturer can teach a core course at a time, it is thought that objectivity control couldn't be sufficient over these courses and gradings.

The aims of this study are not to investigate the quality and benefits of online education. This study aims to investigate and examine the results of a current situation which is the online education period due to Covid-19.

Conclusion and Recommendations

In conclusion, while our study contributes to the growing body of knowledge on online education and its implications for engineering disciplines, there remains a need for continued research to further elucidate the complexities of this transition. By adopting a multidimensional approach and leveraging diverse research methodologies, scholars can advance our understanding of online learning and inform evidence-based practices for promoting student success in the digital age.

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The Effect of WebQuest Teaching Strategy on Students' Critical Thinking Skills and Attitudes Towards Technology

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ABSTRACT

In this study, the effect of WebQuest teaching strategy on 6th grade students' critical thinking skills and attitudes towards technology was examined. In the study, simultaneous embedded design, one of the mixed method research designs, was used. The study was conducted in the 2022-2023 academic year with 48 (Experimental group = 23, Control group = 25) 6th grade students from a secondary school in Bursa province. "Critical Thinking Scale", "Attitude Towards Technology Scale" and "Semi-structured Interview Form" were determined as data collection tools. "Mann Whitney U test" and "Wilcoxon Signed Ranks test" were used to analyze quantitative data, while descriptive analysis and content analysis methods were used to analyze qualitative data. As a result of the research, a statistically significant difference was found between the post-test scores of the experimental group and the control group on the critical thinking and attitude towards technology scale in favor of the experimental group. In addition, it was observed that the instruction made a positive contribution to the motivation and self-confidence of the students, made them interested and enthusiastic about the science course, increased their sense of curiosity and made them like the course more.

Keywords: Critical thinking, attitude towards technology, WebQuest

Introduction

In our age, the rapid development of internet technologies has a great impact on education, as it has on many other areas. Internet technologies have enabled the development and widespread use of second-generation web environment tools in education. These developments affect people's lifelong learning experiences, transform them from individuals who passively receive information to individuals who produce and share information with others, and reshape the roles of teachers and students in education. Accordingly, the frequency of use of web technologies in education is rapidly increasing (Doğan, Bilgiç, Duman & Seferoğlu, 2012). The main reason for this situation is that second-generation web tools increase interaction between users and make it easier to access information collaboratively in a virtual environment (Deperlioğlu & Köse, 2010).

Web 2.0 technologies, which define second-generation web tools, include communication pages and wikis, thus allowing users to collaborate and share (Erkul, 2009). In other words, Web 2.0 is a set of technologies and software applications that allow people to interact, collaborate, create information, and share information with others (Kitsantas & Dabbagh, 2011). In recent years, with the integration of Web 2.0 tools into WebQuests, a current version called WebQuest 2.0 has emerged. WebQuests, which only offered the opportunity to browse static texts in the years they were first developed, have become more flexible and useful than before since they use various Web 2.0 tools with the current version developed by Cherner & Fegely (2017).

WebQuest, developed by Bernie Dodge in 1995 to help teachers integrate technology and the web into their lessons, is an inquiry-oriented activity in which students obtain most or all of their information from the internet (Dodge, 1995). In this context, WebQuests, which are a constantly evolving and dynamic internet technology that uses web-based resources, can also be defined as teacher-created web-based lessons (Kaur & Kauts, 2018; Vidoni & Maddux, 2002).

Unlike the lecture method, WebQuest is a more student-centered teaching method in which the teacher sets a frame of reference and assumes the role of a guide (Zendler & Klein, 2018). WebQuests are structured, organized, time-efficient tools used by educators to present a wide range of Internet information to students, giving students the

opportunity to use critical thinking skills (Buffington, 2007; Vidoni & Maddux, 2002). Well-designed WebQuests encourage students to work collaboratively by enabling communication, group work, problem solving, information processing, critical and creative thinking (Agrawal, 2022; Chan, 2007). WebQuest is an extremely flexible and effective learning method as it enables the organization of classroom and extracurricular activities together (Synekop, 2020).

All WebQuests have a standardized format that includes an introduction to engage students, a task description, a step-by-step description of the process to be followed, a set of web-based resources to be used, assessment criteria and a conclusion. This format, which every WebQuest has, consists of six parts (Schrum & Levin, 2009). These are:

Introduction: In this step the learner is oriented to the topic and the problem. The focus of the topic is introduced here, often providing a real-life scenario. In this section the teacher may explicitly mention certain new concepts or principles to prepare the student for the lesson. This section should be engaging, motivating and relevant (Dodge, 2001; Turville, 2013).

Task: This step focuses on what the students need to do. It usually indicates a specific problem to be solved. It is the part where students are given information or explanation about what they are expected to create as a final product when they complete the activities (Dodge, 2001; Lyons, 2008).

Process: This step is where the teacher guides the students through the different steps to reach their goal, the task. The steps can be divided into different, clear and simple subtasks so that all students can easily follow the activity. This section also includes the roles of the learners. The process phase should usually have one or sometimes several products that students are expected to present at the end of the WebQuest and which will form the basis for the final evaluation phase (Dodge, 2001; Dudeney, 2007).

Resources: This step consists of a list of websites that will be used by the students to complete the tasks and that the teacher has pre-selected. To enrich the resources it is very important to include not only web pages but also other types of resources such as videos, songs, maps, etc. This information needs to be specific and carefully selected by the teacher. Pre-selecting resources not only allows the student to focus directly on the content rather than searching and surfing the Internet, but also gives the teacher some control over the specific websites that students will access (Bauer, 2020; Dodge, 2001; Dudeney, 2007).

Assessment: This section includes information on how the information collected will be organized, how the results will be evaluated, and what the evaluation criteria are; in short, it is the section in which it is explained how student performance will be evaluated and rubrics with criteria are given to students (Dodge, 2001). Assessment can be done by teachers, students themselves or their peers (Chatham, 2021).

Conclusion: This is the section where the work done by the students is put forward, what has been learned is summarized and reflected. In this step, thoughts about the results and outcomes are shared with the students. This section provides the closure of WebQuest by encouraging students to continue researching on the topic, reflect on the process and generalize their learning, if any, to other situations (Bauer, 2020; Coil, 2007; Dodge, 2001).

When the literature on WebQuest is examined, it is seen that these studies have a positive effect on the academic success of the students (Abbitt & Ophus, 2008; Badmus et al., 2019), contribute positively to their retention levels (Ballıel, 2014; Doğru & Şeker, 2012; Gürgil, 2019; Ünal et al., 2018; Yenmez et al., 2017), increase the students' desire to study (Aslantaş & Tertemiz, 2017; Gürleroğlu, 2019; İzgi & Kalaycı, 2020) and develop cooperative learning skills (Çalgın & Koç, 2017; Irmak, 2021; Katrancı, 2014). It is seen that the studies conducted at the national level are generally carried out on a subject or unit belonging to English or information technologies courses (Bilir & Özdilek, 2024). In this study, WebQuest-supported science activities were carried out in different learning areas in four different units.The reason for the activities and applications in four different units representing each subject area is to measure the effect of the method in different subject areas and to evaluate the effect in different subject areas. In addition, in many studies, variables such as attitudes towards technology and critical thinking skills were investigated in very short periods of time. In our study, since it was thought that the effect of critical thinking and attitude towards technology variables would emerge over a long period of time, the change in these variables was measured at the end of the four units. All activities were carried out through a unique website created by the first researcher. In addition, it is also thought that the WebQuest teaching strategy, which will make students' learning processes more beneficial and at the same time make the learner active in the process, will save students from the boredom of traditional education. In addition, it was found appropriate

to use the WebQuest teaching strategy in this study in order to provide guidance for the problems that occurred during the implementation of the activities carried out using the WebQuest teaching strategy and during the implementation of the method. It is thought that the use of all these activities is important for the literature and will fill a gap.

Purpose of the Study

The purpose of this study is to examine the effects of WebQuest instructional strategy on critical thinking skills and attitudes towards technology of sixth grade students. The sub-problems of the study are as follows:

- Is there a significant difference between the critical thinking skills of the experimental group students who were taught with WebQuest and the control group students who were taught with curriculum-based instruction?
- Is there a significant difference between the attitudes towards technology of the experimental group students who were taught with WebQuest and the control group students who were taught with curriculum-based instruction?
- What are the opinions of the experimental group students about the use of WebQuest teaching strategy?

Methods

Research Design

In this study, a simultaneous embedded design, which is one of the mixed methods, was used. This design has a secondary database that provides a supporting role to the primary method that guides the research (Creswell, 2009). The embedded design is a research design in which a single data set is not sufficient to answer all research questions and qualitative data are integrated into an experimental design as secondary data (Baran, 2019; Creswell & Plano Clark, 2017). Similarly, in this study, qualitative data were used to support the quantitative results of the experimental application.

Research Group

The study was conducted with 48 6th grade students in Nilüfer district of Bursa in the 2022-2023 academic year. The experimental group consisted of 23 students and the control group consisted of 25 students. The school where the application was carried out was selected with the appropriate case sampling method. The main factor in the selection was that the researcher worked in the same school and was familiar with the school climate. The students were randomly assigned to the groups. One of the 6th grade classes in the school was assigned as the experimental group and the other as the control group

Data Collection Tool

While "Critical Thinking Scales" and "Attitude Towards Technology Scale" were used to collect quantitative data, "Semi-structured Interview Form" was preferred to collect qualitative data. Necessary permissions were obtained from individuals and institutions during the data collection process.

Critical Thinking Scales

"Critical Thinking Scales" developed by Demir (2006) were used in the study. These scales were developed by focusing on critical thinking skill areas such as inference, evaluation, explanation, analysis, self-regulation and interpretation. The scale consisted of 6 subscales and 56 questions. The reliability coefficients of the developed scale were calculated as Analysis Scale: .70, Evaluation Scale: .85, Inference Scale: .69, Interpretation Scale: .75, Explanation Scale: .75 and Self-Regulation Scale: .91. The maximum score that can be obtained from the scales is "56" and the minimum score is "0" (Demir, 2006). Critical thinking scales were applied to the students before and after the application.

Attitude Towards Technology Scale

The "Attitude Towards Technology Scale" adapted into Turkish by Yurdugül and Aşkar (2008) was used in the study. The reliability coefficient for all items of the scale was found to be .57. The scale is organized in five-point Likert type and contains a total of 24 items. These items are divided into four different sub-dimensions. These are "Attitude towards Technology", "Disadvantages of Technology", "Benefits and Importance of Technology" and "Technology Access". The scale consists of 7 negative and 14 positive statements. Participants rate each statement between 1 and 5. For negative statements, this scoring is reversed (Yurdugül & Aşkar, 2008). Attitude towards technology scale was applied to the students before and after the implementation.

Semi-Structured Interview Form

The researcher prepared a semi-structured interview form in order to reveal the views of the group about the use of WebQuest teaching strategy. The prepared questions were submitted to the opinions of three faculty members in order to ensure face and content validity, and the interview form was reorganized and finalized to consist of 8 open-ended questions in line with the suggestions received. Care was taken to ensure that the interview form included questions about each variable in the study. The 3rd and 4th questions of the form were prepared for the critical thinking

variable (for the 1st sub-problem), the 1st and 2nd questions were prepared for the attitude towards technology variable (for the 2nd sub-problem), and the other questions were prepared to obtain opinions on the 3rd sub-problem of the research.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Bursa Uludag University Research and Publication Ethics Committee (Date: 02.07.2021, Number: 2021-06)
- Informed consent has been obtained from the participants.

Data Analysis

In this study using simultaneous embedded design, the researcher collected quantitative data before and after the implementation and qualitative data during and after the implementation in order to reveal the effects of the WebQuest teaching strategy. Quantitative data were collected using "Critical Thinking Scales" and "Attitude Towards Technology Scale", while qualitative data were collected using "Semi-structured Interview Form". The quantitative data obtained with the data collection tools used to answer the sub-problems of the study were analyzed using SPSS 23 software. Since the number of data for both groups in the study was less than 29 (Kalaycı, 2010), the normality of the attitude towards technology scale and critical thinking scales was analyzed with the "Shapiro-Wilk" test and in some cases with skewness and kurtosis values. Nonparametric analyses are performed when the number of individuals studied is less than 30 (Işığıçok, 2022). Since the number of individuals studied was less than 30 and most of the data did not fit the normal distribution, nonparametric analyses were performed in the tests. Mann Whitney-U test and Wilcoxon Signed Ranks test were used to analyze the relevant data. When a significant difference was found in the results obtained from the study, the "eta squared effect size value" was calculated in order to determine the effect size of the significant difference. At the end of the experimental implementation, focus group interviews were conducted with the student groups in which the experimental implementation process was carried out using a semi-structured interview form. The interviews were conducted one by one with the researcher and each focus group in the school's information technologies classroom. With the permission of the students and parents, all the answers received from the students were recorded with a voice recorder. The interviews lasted approximately 6 class hours. In the qualitative part of the study, the data obtained from the focus group interviews with the students using semi-structured interview questions were evaluated using descriptive and content analysis methods.

Validity and Reliability

In line with ethical principles, necessary permissions were obtained from the relevant authorities for the scales used in the study. It was explained to the students that a scientific research would be conducted and detailed information about the study was given.

Since the mixed method approach was adopted in the study, validity and reliability criteria and concepts were realized within the framework of criteria suitable for both quantitative and qualitative research approaches. The validity and reliability calculations of the critical thinking scales and attitude towards technology scales used in the quantitative dimension of the study were made by the scale owners. In qualitative research, the concepts of consistency and verifiability are emphasized instead of reliability, and the concepts of credibility and transferability are emphasized instead of validity (Sönmez & Alacapınar, 2019).

In order to ensure credibility (internal validity) in the qualitative dimension of the study, a long time was spent with the students in the field and the development of the students was observed over a long period of time. In order to increase credibility, data collection tools were enriched and thus an in-depth understanding was achieved. Again, in order to increase the credibility of the study, the answers given by the students to the questions in the focus group interview were given as direct quotations using descriptive analysis in the findings section. In addition, the focus group interviews were conducted by the researcher, and with the permission of the students and parents, the interviews were audio-recorded with a cell phone. After the recordings were analyzed and transcribed, these recordings were kept. After the data recorded by the researcher were analyzed and transcribed, the first version of these analyzes was presented to the students and the students stated that the data belonged to them. In order to fulfill the criterion of transferability, which is the equivalent of external validity in quantitative research, "detailed description" was made and "purposive sampling" was used. In order to examine whether the data obtained from the study were consistent or not, a faculty member contributed to the research as an external observer at every stage of the research and every stage of the study, such as the creation and implementation of the study and data collection tools, was examined by this expert in order to ensure the consistency criterion. In order to ensure the verifiability condition in the study, the confirmation review method was used, and the findings obtained from the study were determined and checked whether they were obtained from the raw data by getting support from a faculty member. In addition, all raw data

obtained from the research were stored to be presented upon request.

Results

After the analysis of the data obtained during the study, the findings are given under the subheadings "Regarding Critical Thinking Skills", "Regarding Attitude Towards Technology" and "Findings and Comments on Student Opinions".

Findings and Comments on Critical Thinking Skills

The pre-test and post-test score means and standard deviations of the students in the experimental and control groups on the critical thinking scale are given in Table 1.

Table 1.
Critical Thinking Scale Pre-test Post-test Score Means and Standard Deviations

Group	n	Pre-test		Post-test	
		$\overline{x}$	ss	$\overline{x}$	ss
Experiment	23	48.60	7.34	48.65	3.74
Control	25	47.56	7.44	42.0	6.83

As seen in Table 1, the mean scores of the groups on the critical thinking scale before and after the application are different from each other. While the mean score of the students in the experimental group on the pre-test of the critical thinking scale was 48.60 before the application, it became 48.65 after the application. The mean scores of the students in the control group on the pre-test and post-test of the critical thinking scale were found to be 47.56 and 42.0, respectively. According to this finding, the mean score of the students in the experimental group on the post-test of the critical thinking scale was higher than the mean pre-test score, while the opposite result was found for the students in the control group.

Wilcoxon signed rank test was used to determine whether there was a statistically significant difference between the critical thinking pre-test and post-test scores for dependent samples (See Table 2).

Table 2.
Wilcoxon Signed Rank Test Analysis Results for the Critical Thinking Scale of the Experimental and Control Groups

	Group	Test Type	n	Z	*p*
Critical Thinking Scale	Experiment	Pre-test	23	.564	.573
		Post-test	23		
	Control	Pre-test	25	2.518	.012
		Post-test	25		

When Table 2 is examined, it is seen that there is no statistically significant difference between the pre- and post-test scores of the critical thinking scale in the experimental group (Z= -.564, p=.573). Therefore, it can be concluded that the WebQuest teaching strategy does not contribute to the critical thinking skills of the students in the experimental group. On the other hand, it is seen that there is a statistically significant difference between the pre- and post-test scores of the critical thinking scale of the control group (Z= -2.518, p=0.012). However, the post-test scores of the students in the control group are lower than the pre-test scores. This supports the conclusion that program-based teaching is ineffective in increasing the general critical thinking skills of the control group students. It is thought that the fact that the critical thinking scales consist of a large number of pages and questions may have distracted the students and therefore caused the post-test scores to be lower than the pre-test scores.

Mann Whitney-U test was conducted to determine whether there was a statistically significant difference between the critical thinking pre-test and post-test scores for independent samples. The results are presented in Table 3.

Table 3.
Mann Whitney-U Test Analysis Results Regarding the Critical Thinking Scale of the Experimental and Control Groups

Group	Test Type	n	U	Z	*p*
Experiment	Pre-test	23	258.0	-.61	.54
Control		25			
Experiment	Post-test	23	101.0	-3.85	.00
Control		25			

According to the pre-test results, there is no statistically significant difference between the groups (U=258.00, Z= -.610, *p*=.542). These findings show that the students in the experimental and control groups were at similar levels in terms of critical thinking skills before the experimental application. Therefore, it can be concluded that there is equivalence between the groups in terms of critical thinking skills.

The post-test scores of the experimental and control groups, a significant difference was found in favor of the experimental group in terms of critical thinking skills (U=101.00, Z=-3.858, *p*=.00). When the ranking averages are taken into account, the post-test scores of the students in the experimental group are higher than those in the control group. However, this difference does not mean that there is an increase in the critical thinking skills of the experimental group students as a result of the WebQuest applications.

The results of the Mann Whitney-U test analysis of the post-test scores of the experimental and control groups according to the critical thinking sub-dimensions are presented in Table 4.

Table 4.

Mann Whitney-U Test Analysis Results of Post-test Scores of Experimental and Control Groups According to Critical Thinking Sub-Dimensions

Sub-dimensions	Group	n	Rank Averages	U	Z	*p*
Analysis	E	23	27.83	211.0	-1.66	.09
	C	25	21.44			
Evaluation	E	23	31.61	124.0	-3.51	.00
	C	25	17.96			
Inference	E	23	34.74	52.0	-5.06	.00
	C	25	15.08			
Interpretation	E	23	34.85	49.50	-5.00	.00
	C	25	14.98			
Explanation	E	23	33.89	71.50	-4.55	.00
	C	25	15.86			
Self-regulation	E	23	18.57	151.0	-2.82	.00
	C	25	29.96			

*$p \leq .05$, E=Experiment, C=Control.

According to Table 4, when the post-test mean scores of the experimental and control groups are examined according to the critical thinking analysis dimension, it is seen that the post-test mean ranking of the experimental group (27.83) is higher than the post-test mean ranking of the control group (21.44). According to the results, no significant difference was found between the post-test scores of the experimental and control groups in terms of the critical thinking analysis sub-dimension (U=211.00, Z= -1.66, *p*=.09). These results show that the experimental group cannot be statistically distinguished from the control group in terms of general critical thinking skills.

In the critical thinking evaluation sub-dimension of the experimental group, the post-test ranking average (31.61) was higher than that of the control group (17.96), indicating the superiority of the experimental group in evaluation skills. A significant difference was found between the experimental and control groups in the critical thinking evaluation sub-dimension (U=124.00, Z= -3.51, *p*=.00). The eta squared value obtained was calculated as .10, which indicates a medium effect size according to the criteria specified by Büyüköztürk (2013) (.10<.14). These findings reveal that the experimental group can be statistically distinguished from the control group in terms of evaluation skills.

In the inference sub-dimension, the post-test mean rank of the experimental group (34.74) is significantly higher than the post-test mean rank of the control group (15.08), which shows the superiority of the experimental group in inference skills. According to the results, a significant difference was found between the experimental and control groups in the critical thinking inference sub-dimension (U=52.00, Z= -5.06, *p*=.00). The calculated eta squared value was found to be .45, which indicates a large effect size (.45>.14). The results show that the experimental group is statistically significantly different from the control group in terms of inference skills.

In the interpretation sub-dimension, the post-test rank average of the experimental group (34.85) is significantly higher than the post-test rank average of the control group (14.98), which shows the superiority of the experimental group in interpretation skills. A significant difference was found between the experimental and control groups in the critical thinking interpretation sub-dimension (U=49.50, Z= -5.00, *p*=.00). The calculated eta square value was found to be .46, which indicates a large effect size (.46>.14). These findings show that the experimental group was statistically significantly different from the control group in terms of interpretation skills.

In the explanation sub-dimension, the post-test rank average of the experimental group (33.89) is significantly higher than the post-test rank average of the control group (15.86), which shows the superiority of the experimental group in explanation skills. According to the results, a significant difference was found between the experimental and control groups in the critical thinking explanation sub-dimension (U=71.50, Z= -4.55, *p*=.00). The calculated eta squared value was found to be .37, which indicates a large effect size (.37>.14). These findings show that the experimental group is statistically significantly different from the control group in terms of explanation skills.

In the self-regulation sub-dimension, the post-test mean rank of the experimental group (18.57) is significantly lower than the post-test mean rank of the control group (29.96), indicating the superiority of the control group in self-regulation skills. According to the results, a significant difference was found between the experimental and control groups in the critical thinking self-regulation sub-dimension (U=151.00, Z= -2.82, *p*=.00). The calculated eta squared value was found to be .15, indicating a large effect size (.15>.14). These results show that the control group is statistically significantly different from the experimental group in terms of self-regulation skills.

According to the results, a significant difference was found in the critical thinking skill levels of the groups in all sub-

dimensions except the analysis sub-dimension. Results were obtained in favor of the experimental group in the evaluation, inference, interpretation and explanation sub-dimensions, and in favor of the control group in the self-regulation sub-dimension. The eta squared values calculated according to the sub-dimensions were determined as .10, .45, .46, .37, .15, respectively. It was observed that the significant difference between the post-test mean scores of the experimental and control group students, except for the evaluation sub-dimension, was at a large level. In the evaluation sub-dimension, the significant difference in favor of the experimental group (.10<.14) was found to be at a medium level. These findings indicate that the experimental process applied to the experimental group was generally effective, but that it needs to be improved in the analysis and self-regulation sub-dimensions.

Findings and Comments on Attitudes Towards Technology

In this part of the research, the answer to the second sub-problem of the study was sought. In Table 5, the pre-test and post-test mean scores and standard deviation values for the attitude scale towards technology are presented.

Table 5.

Attitude Scale Towards Technology Pre-test Post-test Mean Scores and Standard Deviations

Group	n	Pre-test		Post-test	
		$\overline{x}$	ss	$\overline{x}$	ss
Experiment	23	3.25	.58	3.82	.42
Control	25	3.17	.34	3.20	.64

According to Table 5, differences are observed between the mean scores of the groups on the attitude scale towards technology before and after the experimental application. While the mean pre-test score of the attitude scale towards technology of the students in the experimental group was 3.25, it was recorded as 3.82 after the experimental application. The attitude scale pre-test and post-test mean scores of the students in the control group were determined as 3.17 and 3.20, respectively. According to these findings, it was observed that the post-test mean scores of the students in the experimental and control groups on the attitude scale towards technology were higher than the pre-test mean scores.

The Mann Whitney-U test results for the attitude scale towards technology are presented in Table 6.

Table 6.

Mann Whitney-U Test Analysis Results Regarding the Attitude Scale Towards Technology for the Experimental and Control Groups

	Mann Whitney-U					
	Group	Test Type	n	U	Z	*p*
Attitude Scale Towards Technology	*Exp. Control	Pre-test	23 25	284	-.07	.94
	*Exp. Control	Post-test	23 25	106	-3.74	.00

* Experiment

According to the pre-test results, there is no statistically significant difference between the groups (U=284.00, Z= -.072, *p*=.942). This shows that the attitude levels of the experimental and control groups towards technology were similar before the application. However, a significant difference was found between the post-test scores of the groups' attitude scale towards technology in favor of the experimental group (U=106.00 Z= -3.748, *p*=.000). The post-test scores of the students in the experimental group were statistically significantly higher than those in the control group. According to the findings, the calculated eta square value (.77>0.14) indicates a large effect size. The results obtained show that the WebQuest teaching strategy contributes positively to the students' attitudes towards technology (See Table 6).

Table 7.

Wilcoxon Signed Rank Test Analysis Results Regarding Pre-test and Post-test Scores of the Attitude Scale Towards Technology of the Experimental and Control Groups

Wilcoxon Marked Ranks					
	Group	Test Type	n	Z	*p*
Attitude Scale Towards Technology	*Exp.	Pre-test	23	2.66	.00
		Post-test	23		
	Control	Pre-test	25	.386	.70
		Post-test	25		

* Experiment

Table 7 presents the Wilcoxon Signed Rank test results for the attitude scale towards technology for the experimental and control groups. The analyses show that there was a significant increase in the attitude of the experimental group towards technology; a statistically significant difference was found between the pre-test and post-test scores of the experimental group's attitude towards technology (Z=2.66, *p*=.008). The eta squared value was calculated as .24, which indicates a large effect size (.24>.14). These findings show that the WebQuest teaching strategy positively affected the attitudes of the students in the experimental group towards technology.

According to the Wilcoxon Signed Rank test findings performed on the pre-test and post-test scores of the attitude scale towards technology belonging to the control group, no significant difference was found between the pre-test and post-test scores of the control group students (Z= .386, *p*=.70). This finding shows that program-based teaching did not provide a significant change in the attitudes of the control group students towards technology.

Findings and Comments on Student Opinions

The third sub-problem of the study is; "What are the opinions of the experimental group students regarding the use of the WebQuest teaching strategy?" For this purpose, qualitative data collection tools were used and researcher observations and student interviews were used. Interviews were conducted with students in focus groups of 3-4 people using the "Semi-Structured Interview Form" consisting of 8 questions. The findings from the interview questions are given below. Table 8 shows the content analysis results of the students' computer and internet usage levels before they used the WebQuest teaching strategy in science courses.

Table 8.

Results of Content Analysis of Students' Computer and Internet Usage Levels Before Teaching Science Courses with WebQuest Teaching Strategy

Theme	**Cat	Codes	Freq. (f)	Percent (%)
Computer and Internet Use Before WebQuest	No	--	7	21.21
	Very little	Listening to music	2	24.24
		Playing games	4	
		Watching videos	2	
	Yes	Listening to music	4	54.55
		Playing games	9	
		Watching videos	4	
		Recipe	1	
	Total		33	100

* Some students expressed more than one opinion. **Category

When the opinions regarding the question "What is your level of computer and internet usage before teaching your science courses with WebQuest activities?" in the focus group interview conducted within the scope of the research were examined; 21.21% of the students stated that they did not use computers and internet before the WebQuest teaching strategy or could not use them because they did not know how to use them. 24.24% of the students stated that they used them very little/rarely before the WebQuest learning strategy, and 54.55% of them stated that they used computers and internet.

Some of the views of the students in the group (21.21%) who did not use/could not use computers and the internet before the WebQuest teaching strategy are as follows: "*I did not use the computer much before, it was just sitting on the side* (S5)" "*I had never used a computer before until I met WebQuest* (S7)" "*I used to never use a computer before, I could not use it* (S20)"

Before the WebQuest teaching strategy, the students in the group who used the computer and the internet very little (24.24%) used the computer and the internet for purposes such as listening to music (2), watching videos (2) and playing games (4). Some of the student opinions on this are as follows: "*I did not use the computer very often before. When I did, I mostly used it to play games and watch videos* (S6)" "*I did not know how to use the computer before, I only used the computer for playing games* (S18)" "*Before WebQuest, I could hardly do anything on the computer, I did not know anything about computers, I used to open YouTube, listen to music and play games* (S3)"

Students who used computers and the internet before the WebQuest teaching strategy (54.55%) stated that they used computers and the internet for recipes (1), listening to music (4), watching videos (4) and playing games (9). Some of the student opinions on this are as follows: "*Before WebQuest, I used the computer mostly for entertainment purposes* (S1)" "*Before this method, I did not use the internet and the computer for studying. I used them mostly for watching videos and playing games* (S9)" "*For example, I used the internet mostly for recipes* (S10)" "*Before WebQuest, I used the computer for games and sometimes I researched things I did not know* (S11)"

From here, it is understood that most of the students (78.79%) used computers and the internet more or less before teaching science courses with the WebQuest teaching strategy. When the purposes of students' computer and Internet use are examined, it is seen that they use them mostly for entertainment purposes such as listening to music, watching videos and playing games.

Table 9 shows the results of content analysis regarding the students' computer and internet usage levels and the development of their computer and internet usage skills after teaching science courses with the WebQuest teaching strategy.

Table 9.
Results of Content Analysis on the Development of Computer and Internet Usage Levels and Computer and Internet Usage Skills of Students After Teaching Science Courses with WebQuest Teaching Strategy

Theme	**Cat.	Codes	Freq. (f)	Percent (%)
Computer and internet usage level and skill developmen	Positive Impact	Doing research	15	39.48
		Studying	7	18.42
		Preparing a presentation	7	18.42
		Topic repetition	2	5.26
		Doing homework	3	7.90
		Playing games	4	10.52
		Total	38	100

* Some students expressed more than one opinion.
** Category

When the content analysis results of the focus group interview conducted within the scope of the research regarding the question "To what extent did your computer and internet usage level and skills improve after WebQuest activities?" were examined, it was seen that all students' computer and internet usage levels and skills increased after teaching science courses with the WebQuest teaching strategy. After completing their lessons with the WebQuest teaching strategy, students started to use computers and the Internet for purposes such as doing research (39.48%), studying (18.42%), preparing presentations (18.42%), doing homework (% 7.90), and reviewing topics (5.26%). It can be said that some of the students (10.52%) continue to use computers and the Internet for playing games as they did before.

Some of the opinions of students (39.48%) who used computers and the internet for research purposes after teaching science courses with the WebQuest teaching strategy are as follows: "I used to not research topics that I don't know, but now I do. Thanks to this, my research skills and typing skills have improved (S3)" "With WebQuest, my research skills on the internet have improved, and I have also improved myself. I am now using a computer to do research (S6)" "I think WebQuest has increased my computer and internet usage skills. Now, instead of just surfing the internet, I am also using it for my homework. Now, I use well-known, reliable sites when researching information (S10)" "After WebQuest, I can do research much faster. After WebQuest, my research and typing speed has increased (S12)"

Some of the opinions of students (18.42%) who used computers and the internet for studying purposes after teaching science courses with the WebQuest teaching strategy are as follows: "After WebQuest, I now use the computer for studying, doing research and taking notes (S2)" "After WebQuest, I learned how to use the computer better, I learned how to prepare and give presentations. Since I use the computer more for teaching purposes, my father bought me a new computer (S9)" "After I met WebQuest, I started playing games very little. Now, I watch useful content to contribute to my lessons. I watch educational videos about lessons (S18)"

Some of the opinions of students (18.42%) who used computers and the internet for presentation preparation after teaching science courses with the WebQuest teaching strategy are as follows: "I learned that computers are not just games, I learned how to make a Powerpoint presentation (S21)" "I learned how to prepare and give a presentation. This will be useful in my other classes as well. My self-confidence increased (S13)" "For example, I did not know how to prepare a presentation. I was typing slowly on the keyboard, I could not find the letters. After I met WebQuest, I can type smoothly, I learned how to prepare and give a presentation (S2)"

Some of the views of students (10.52%) who used computers and the internet for gaming purposes after teaching science courses with the WebQuest teaching strategy are as follows: "*Nothing changed in terms of gaming after WebQuest, but I started doing more research* (S11)" "*After WebQuest, the frequency of watching videos decreased, but I still play games* (S16)"

The opinions of students (7.90%) who used computers and the internet for homework purposes after teaching science courses with the WebQuest teaching strategy are as follows: "I can now use the computer better, I can write faster and I now do my work on the computer. That is why I do more research and use the computer when doing my homework (S14)" "*After WebQuest, I started doing most of my research on the computer* (S23)" "*I think WebQuest increased my computer and internet usage skills. Now I use it for my homework instead of just surfing the internet* (S10)"

The opinions of the students (5.26%) who used computers and the internet for repetition purposes after teaching science courses with the WebQuest teaching strategy are as follows: "*With WebQuest, I started using the computer for research, preparing presentations, studying and repetition* (S4)" "*WebQuest was very good for repetition of topics and reinforcing information* (S13)"

Table 10 shows the results of the content analysis regarding the change in students' interest levels towards technology after teaching science courses with the WebQuest teaching strategy.

Table 10.
Results of Content Analysis on the Change in Students' Interest Levels in Technology After Teaching Science Courses with WebQuest Teaching Strategy

Theme	**Cat.	Codes	Freq. (f)	Percent (%)
Interest in Technology	Positive Impact	Positive Attitude	5	21.74
		Increased interest	10	43.46
		Awareness formation	1	4.35
		Curiosity	2	8.70
		Love of technology	1	4.35
		Willingness	2	8.70
		Keeping up with technological developments	2	8.70
Total			23	100

** Category

When the content analysis results of the focus group interview conducted within the scope of the research were examined regarding the change in the interest levels of the students towards technology after they taught their science courses with the WebQuest teaching strategy regarding the question "Did teaching the science course in this way cause any change in your interest in technology? If so, can you explain it?", all of the students (100%) stated that the WebQuest teaching strategy provided them with an interest in technology or increased their current interest. 43.46% of the students stated that WebQuest increased their interest in technology, 21.74% developed a positive attitude towards technology, 8.70% increased their desires, 8.70% became curious about technology, 4.35% became aware, 4.35% loved technology, and 8.70% followed technological developments.

43.46% of the students stated that WebQuest increased their interest in technology. Some of the student opinions on this issue are as follows: "*I was not as interested in computers as I am now. After the WebQuest projects we carried out, I became more interested in technology* (S5)" "*I used to think that creating a website was a very difficult thing, but after you created this WebQuest site and explained it to us, I researched it and saw that it was not so difficult. Technology is generally something that attracts me, it is a field that I am interested in. Thanks to WebQuest, my interest in technology increased even more* (S7)" "*There has been a change in my interest in technology. I used to not use technology for my lessons, now I have learned that the internet can be used for different purposes* (S18)"

21.74% of the students stated that WebQuest helped them develop a positive attitude towards technology. Some of the student opinions on this issue are as follows: "*Before this strategy, I was not very interested in technology and social media. WebQuest contributed a lot to me, my manual skills improved. Now I have a more positive view of technology* (S2)" "*After the WebQuest strategy, I approach technology with more sympathy. I can say that my view of technology has changed positively* (S3)" "*Yes, my interest has increased. I have gained awareness, I have seen that technology contributes to us more. I can say that my view of technology has changed positively* (S9)"

8.70% of the students stated that WebQuest made them more enthusiastic about technology. The student opinions about this are as follows: "*My interest and enthusiasm for technology increased. I learned to use the computer better* (S15)" "*I used to not look at the computer much, but later I started to spend more time with the computer, especially in terms of lessons. "My willingness has increased* (S16)"

8.70% of the students stated that WebQuest triggered their curiosity about technology. The student opinions about this are as follows: "*Previously, I was not interested in technological devices such as phones, computers, tablets. After WebQuests, I became more interested in technology* (S12)" "*Thanks to this study, I started to wonder about many things and started to research. Since my interest in technology has increased, I now use the computer more often and faster* (S19)"

8.70% of the students stated that WebQuest enabled them to follow technological developments. Student opinions on this matter are as follows: "*My perspective on technology has changed with WebQuest. A new development or news about technology arouses curiosity in me and excites me. My trust and awareness of the Internet has increased. I used to believe in every piece of news and information, now I research the accuracy of information on the Internet* (S1)" "*The latest developments in technology now attract my attention more. For example, flying cars attract my attention, new phones attract my attention. For example, some phones are charged with the energy they receive from the sun. I do research on science, engineering marvels attract my attention* (S17)"

One student (4.35%) stated that WebQuest made him love technology. The student's opinion on this is as follows: "After these applications we did, I realized that other things could be done on the computer, that it was a small world. This made me love and be interested in computers and the internet more (S13)"

Table 11 shows the results of the content analysis of students' views on the contribution of the WebQuest teaching strategy to their thinking skills.

Table 11.
Results of Content Analysis of Students' Views on the Contribution of WebQuest Teaching Strategy to Thinking Skills

Theme	Category	Codes	Freq. (f)	Percent (%)
Contribution to thinking skills	Positive Impact	Activities used	12	48
		Group work	3	12
		Using the webquest site	1	4
		Daydreaming	2	8
		Designing activity	4	16
		Positive attitude towards the lesson	2	8
		Interest and curiosity	1	4
Total			25	100

* Some students expressed more than one opinion.

When the content analysis results of the views of the students on the contribution of the WebQuest teaching strategy to their thinking skills regarding the question "Do you think that the WebQuest teaching strategy improves your thinking skills? If yes, how?" of the focus group interview conducted within the scope of the research were examined, all of the students (100%) stated that the WebQuest teaching strategy made a positive contribution to their thinking skills. 48% of the students stated that the activities used during WebQuests, 16% due to activity design, 12% due to group work, 8% due to daydreaming during WebQuests, 8% due to positive attitudes towards the course, 4% due to using the WebQuest site and 4% due to the development of interest and curiosity towards the course improved their thinking skills.

48% of the students stated that the activities used during the WebQuests contributed positively to their thinking skills. Some student opinions on this are as follows: "*Yes, while doing the activities, they are done in a certain way, but we constantly thought about how we could do it differently as a group. I think my thinking skills improved thanks to this* (S1)" "*I think my thinking skills improved thanks to WebQuest, because we were very active thanks to WebQuests, we learned a lot of things. The activities we did improved and supported our thinking skills* (S2)" "*Yes, I think it improved. The activities in the WebQuest, the summaries we made after watching the videos, using the site for the subjects we were bad at, repeating and reinforcing our knowledge, all these improved our thinking skills* (S8)"

16% of the students stated that designing activities during WebQuests contributed positively to their thinking skills. Some student opinions on this issue are as follows: "*Yes, it did. Most of all, I thought a lot while designing the activities* (S12)" "*I was thinking during the design phase while doing the activities, I was thinking while taking notes of important information after watching the videos. This activity environment improved my thinking skills* (S14)"

12% of the students stated that group work during WebQuests contributed positively to their thinking skills. The student opinions on this issue are as follows: "Since we were doing the lessons in groups in WebQuest, I constantly thought, "*Can we be in the best group?" I was thinking while doing the activities in the design phase, and I was thinking while taking notes of important information while watching the videos. This activity environment improved my thinking skills* (S14)" "*It has improved. For example, in some of the poster preparation activities in WebQuests with my friends, I always thought about what would be on the poster and how we should design it. I think more than before when I design something* (S10)" "*When we were doing an activity, we first thought individually with our group friends, then put forward our ideas and agreed on a thought. I think this situation triggered my thinking skills* (S9)"

8% of the students stated that imagining during WebQuests contributed positively to their thinking skills. Student opinions on this issue are as follows: "*Yes, I think this strategy improved my thinking skills. I think I can think more practically thanks to WebQuest. It improved my imagination, I am constantly designing activities and homework in my head* (S18)" "*For example, while preparing posters, we mostly did not use printouts but imagined and drew by ourselves, and during this time we thought about how we could draw the pictures in a more beautiful and interesting way. I think these thinking processes also contributed to our thinking skills* (S1)"

8% of the students stated that the activities and practices

carried out during the WebQuests helped them develop a positive attitude towards the course, and that this contributed positively to their thinking skills. The student opinions on this issue are as follows: "*Previously, I never listened to science lessons, I didn't think, and I didn't participate in the lesson. Now, I like the lesson, I think about the information related to the lesson. I aim to be more successful now. I think it contributed to me* (S7)" *For example, in Turkish lessons, when our teacher said, "Think about this topic," I would close the book and say, "I thought about it," but I wasn't actually thinking about anything. After we started teaching the lessons with WebQuest, my desire and curiosity increased and now I think when I am asked a question about the passage. I think this situation triggered my thinking skills* (S12) "

4% of the students stated that using the WebQuest application site during WebQuests improved their thinking skills. One student's opinion on this is as follows: "*Yes, I think it improved my thinking skills. For example, after watching the videos on the site, I kept thinking about them. This increased my thinking capacity. I used to think about a problem superficially without going into too much detail, but now I think about a problem in more detail* (S20)"
4% of the students stated that the activities and practices carried out during the WebQuests triggered their interest and curiosity towards the course, and that this situation contributed positively to their thinking skills. One student's opinion on this issue is as follows: "*After I started to study the courses with WebQuest, my interest and curiosity towards the course increased. I think this situation triggered my thinking skills* (S12)"

Table 12 asks students whether they tried different methods when looking for a solution to a problem or issue and what they did in this process, and the results of the content analysis of their opinions on this matter are given.

Table 12.

Results of Content Analysis of Students' Views on Trying Different Solution Methods When Looking for a Solution to a Problem or Issue

Category	Codes	Freq. (f)	Percent (%)
Methods of finding a solution to a problem	Getting help from elders	4	22.22
	Using technology	4	22.22
	Using newspapers, books, magazines	3	16.67
	Doing research	7	38.89
	Total	18	100

In the focus group interview conducted within the scope of the research, students stated that they tried different ways to find a solution to a problem or issue in their daily lives in response to the question "Do you try different methods when looking for a solution to a problem or issue? What do you do during this process? Do you think WebQuest contributed to this?" 38.89% of the students stated that they searched for a solution to a problem or issue by doing research, 22% by asking for help from their elders, 22.22% by using technology, and 16.67% by using newspapers, books, and magazines.

38.89% of the students stated that they try to find a solution to a problem or issue in their daily lives by doing research. Some of the student opinions on this are as follows: "*Especially when I am studying, I do research from different sources when solving a problem or a question* (S1)" "*I do detailed research and think in detail. When I encounter a problem, I think of many ways and choose the most appropriate one* (S12)"

22.22% of the students stated that they try to find a solution to a problem or issue in their daily lives by getting help from their elders. Some of the student opinions on this are as follows: "*When I encounter a problem, I try different ways. I try all the ways that come to my mind until the problem is solved. If I cannot find a solution, I ask for help from my elders in the family* (S1)" "*Yes, when I encounter a problem, I try different ways. If I cannot find a solution, I ask my friends, family or elders* (S14)"

22.22% of the students stated that they try to find a solution to a problem or issue in their daily lives by using technology. Some of the student opinions on this are as follows: "*I try all the methods that come to my mind until the problem is solved. Usually one of them solves the problem but if it doesn't, I use technology first* (S1)" "*Yes, I try different methods. For example, when I study, I use not only books but also computers* (S2)" "*I try different methods to find solutions to the problems I encounter in my daily life. I mostly do research on the internet and look for solutions* (S22)"

16.67% of the students stated that they try to find a solution to a problem or issue in their daily lives by referring to newspapers, books or magazines. Some of the student opinions on this are as follows: "*Yes, when I encounter a problem, I try different ways to solve it. For example, while studying, I do research not only in books but also on the computer, magazines etc.* (S2)" "*When I encounter a problem in my life, I think that there are many ways to solve that problem. I try different ways. I do research in books,*

newspapers and magazines (S3)"

Students (52.13%) also stated that they found a solution to a problem or issue more easily after the course process with WebQuest and that WebQuest contributed positively to this process. Some of the student opinions on this are as follows: "*I think WebQuest contributed to this. With this method, I can produce many fast, logical and different solutions* (S1)" "*WebQuest pushed me to try different methods while looking for a solution to a problem. I question more than before that there is more than one solution to a problem* (S2)" "*I think WebQuest contributed to me trying different solutions to problems* (S5)".

Discussion

In this study, in which the effect of WebQuest teaching strategy on 6th grade students' critical thinking skills and attitudes towards technology was examined, it was determined whether there was a difference in the critical thinking skills and attitudes towards technology of the experimental and control group students before the application. The analysis of the pretests of the critical thinking scale and attitude towards technology scale of the experimental and control groups revealed that there was no statistically significant difference between the groups. The fact that there was no difference between the groups at the beginning of the study and the conditions were similar was interpreted positively in terms of the equivalence of the groups. In the use of experimental methods, it is extremely important that the groups have similar pretest scores before the application in terms of equivalence of the groups (Büyüköztürk, 2013; Çepni, 2014). Factors such as selecting the experimental and control groups from the same school branches and students having similar socio-economic conditions can be considered as factors affecting the equality of the groups. In their study on critical thinking levels and factors affecting critical thinking, Öztürk and Ulusoy (2008) determined that demographic characteristics such as place of residence, age, family education status and characteristics such as grade point average and class level affect critical thinking skills. Similarly, Bilgiç and Tosun (2016) also found in their studies on critical thinking levels and factors affecting critical thinking that the grade the student is attending the school he/she graduated from, the level of parental education and family income, and family structure affect the critical thinking levels of students. Other factors that affect the equality of groups can be considered, such as students being selected from the same school branches, living in the same environment, having similar family structures and socio-economic conditions.

In the study, a significant difference was found between the critical thinking skills posttest scores of the groups in favor of the experimental group. It is not enough to say that there was an increase in the critical thinking skills of the experimental group students as a result of WebQuest applications only by looking at this difference. The data obtained from the focus group interviews conducted with the students after the instruction supported that there was an increase in the critical thinking skills of the experimental group students who used the WebQuest instructional strategy. Accordingly, it can be said that the WebQuest instructional strategy used in teaching topics and concepts in science courses is more effective in increasing students' critical thinking skills than the instruction based on the current curriculum. Although there are studies in the literature showing that WebQuest instructional strategy has a positive effect on students' critical thinking skills and supporting the findings of the current study (Bilir & Özdilek, 2022; Liang & Fung, 2020), there are also studies showing the opposite results. For example, Çalgın and Koç (2017) found that the WebQuest strategy applied in 6th grade did not contribute to students' critical thinking skills. In this study, students worked individually in WebQuests and did not do group work. However, the WebQuest strategy is a strategy that prioritizes students' presence in collaborative work environments. The lack of positive results in this study is due to the individual work of the students.

When the results related to the relationship between the groups and sub-dimensions are examined, a significant difference was found in the post-test critical thinking skill levels of the groups in all sub-dimensions except the analysis sub-dimension. There is a significant difference in favor of the experimental group in the evaluation, inference, interpretation and explanation sub-dimensions, and in favor of the control group in the self-regulation sub-dimension. Since the eta square values for the analysis, inference, interpretation, explanation and self-regulation sub-dimensions are above .14, it is seen that the significant difference between the post-test mean scores of the groups except for the evaluation dimension is high, and the significant difference in favor of the experimental group in the evaluation sub-dimension is moderate. The fact that there is no significant difference in all sub-dimensions of the scale in the experimental and control groups suggests that the experimental procedure applied to the students was partially effective on their critical thinking skills. According to the research results, it can be said that the WebQuest teaching strategy improved the students' critical thinking skills of evaluation, inference, interpretation and explanation. It can be thought that this situation may be due to the WebQuest teaching strategy and activities used in the lessons for 20 weeks. The students worked on the WebQuest activities in groups, investigated and questioned

the tasks given in the WebQuests while performing them collaboratively, used their higher-order thinking skills in the meantime, and made presentations to their friends after the activities were completed, answered the questions posed by the class and made various explanations. The results of this study show some similarities with the results obtained by Bilir and Özdilek (2022) regarding the effect of WebQuest-supported research and inquiry strategy on students' critical thinking skills in a different sample group at the same grade level. When the results obtained from the study are compared with the results of Bilir and Özdilek's (2022) study in terms of sub-dimensions, they overlap with the results of the evaluation, inference, interpretation and explanation sub-dimensions, while the results of the analysis and self-regulation sub-dimensions differ. In this respect, the results of the study partially overlap with this study. In the mentioned study, there was no significant difference between the groups in terms of the self-regulation sub-dimension, while in the current study, no significant difference was found between the groups in terms of the analysis sub-dimension. The sub-dimensions may have been affected by other variables or the difference in the sample group may have caused this situation.

The quantitative findings of the study were also supported by the qualitative findings obtained from the focus group interviews held with the students at the end of the education. The experimental group students stated that the WebQuest teaching strategy caused development in their thinking skills and their ability to find solutions to problems when they encountered them in daily life. Students claimed that the activities used in the WebQuest applications, the process of designing these activities, the use of technology, the group work performed and the application site used caused development in their critical thinking skills. The result that the WebQuest teaching strategy has a positive contribution to the students' critical thinking skills is also supported by the qualitative findings in various studies in the literature. Vidoni and Maddux (2002) discussed the theory and practice of WebQuest and projected how WebQuests can develop critical thinking skills in students. The most important conclusion from the study is that WebQuests encourage students to think critically and develop existing critical thinking skills. In another study, Özgeldi and Yakın (2021) revealed that the WebQuest process encourages students to think critically.

When the results obtained regarding the attitude towards technology, which is another variable of the study, are examined, it is revealed that there is a significant difference with a high effect size value in favor of the experimental group between the post-test scores of the attitude scale towards technology. In addition, it is seen that there is a statistically significant difference with a high effect size value between the pre-test and post-test scores of the attitude scale towards technology of the experimental group, but there is no statistically significant difference between the pre-test and post-test scores of the control group students.

At the same time, as a result of focus group interviews conducted with students after the instruction, findings regarding the WebQuest instruction strategy of the experimental group students support the quantitative findings obtained, such as the development of positive attitudes and awareness towards technology, increased interest and curiosity, liking and willingness to use technology, and the desire to follow technological developments. Based on these results, which are presented with both quantitative and qualitative data, it can be said that the WebQuest teaching strategy used in teaching subjects and concepts in science courses is more effective in increasing students' attitudes towards technology than the teaching provided based on the current program. Similarly, when the studies conducted in the literature are examined, there are studies that support this result. Bilir and Özdilek (2022) also taught 6th graders with a WebQuest-supported research and inquiry-based learning strategy and examined the effect of this strategy on students' attitudes towards technology and revealed that WebQuest-supported activities and practices improved students' attitudes towards technology. In another study, Ünal (2012) questioned the effect of the WebQuest strategy on students' attitudes towards web-supported study and revealed that the WebQuest strategy positively affected students' attitudes towards web-supported study. This finding is consistent with the finding obtained from our study. Yilmaz and Aydin (2013) examined the attitudes of 6th, 7th and 8th grade secondary school students towards technology and the factors affecting these attitudes. According to the results of the study, the students stated that their attitudes towards technology were positive because technology was in their areas of interest and useful in their lessons. The findings are consistent with the qualitative findings obtained in our study.

When the literature is examined, it is possible to come across other studies that question students' attitudes towards technology. When these studies are examined, it is seen that various Web 2.0 applications positively affect students' attitudes towards technology. Köse, Bayram, and Benzer (2021) revealed that argumentation applications supported by Web 2.0 tools positively affect students' attitudes towards technology. In another study, Akbaba and

Ertaş-Kılıç (2022) found that implementing science courses with Web 2.0 applications positively affected students' attitudes towards technology. These results are consistent with the results of the study. WebQuest is also one of the Web 2.0-supported strategies, and from this perspective, it can be said that courses supported by these tools positively contribute to students' attitudes towards technology. In courses conducted with Web 2.0 applications, students mostly made applications with tools such as computers, the internet, etc., and it was observed that students who were digital natives and prone to technology in our age became better in this sense.

Conclusion and Recommendations

In this study where the WebQuest teaching strategy was used, it can be said that the WebQuest teaching strategy improved students' attitudes towards technology and critical thinking skills. It was also determined that the teaching provided positively contributed to students' motivation and self-confidence, made students interested and enthusiastic about science lessons, and made them like the lesson more. The following suggestions were presented in line with the results of the research:

- In this study, WebQuest-supported activities and applications were carried out with 6th grade students in four different units representing each subject area. WebQuest-supported activities can be carried out with students in different grades of the secondary school level by integrating them into different teaching strategies and methods.
- In the study conducted, the effect of WebQuest teaching strategy on students' critical thinking skills and attitudes towards technology was examined. In future studies, the effect of WebQuest teaching strategy on different variables can be investigated.
- In order for new WebQuest applications to be more efficient, the Ministry of National Education should provide training to teachers and practitioners to develop their digital competencies such as "Effective use of information and communication technologies" and "WebQuest preparation." Moreover, if these trainings are provided in the form of trainer training, more teachers will be reached across the country, thus increasing the use and quality of WebQuest.
- In classes where the WebQuest teaching strategy will be used, the class should be divided into separate groups of 3-4 students from all achievement levels and students should be encouraged to work together. It is recommended that groups are not crowded so that students do not have difficulty dividing the work.
- In studies to be carried out with the same strategy, the impact on academic success, knowledge retention and digital literacy can also be investigated.

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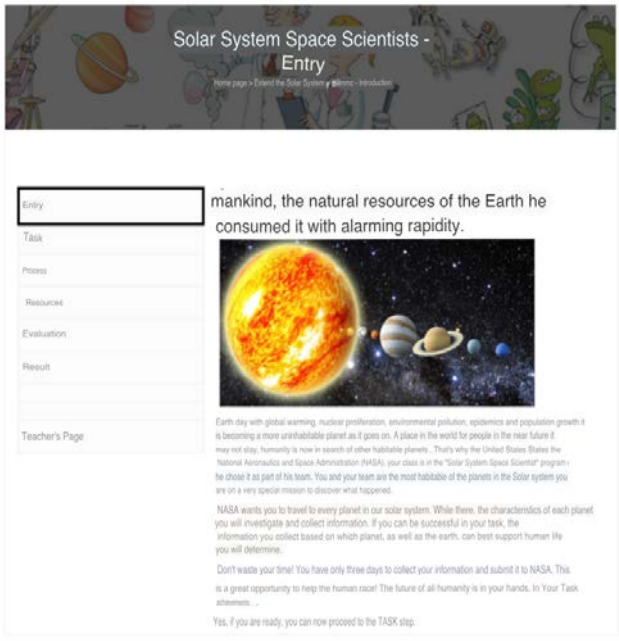
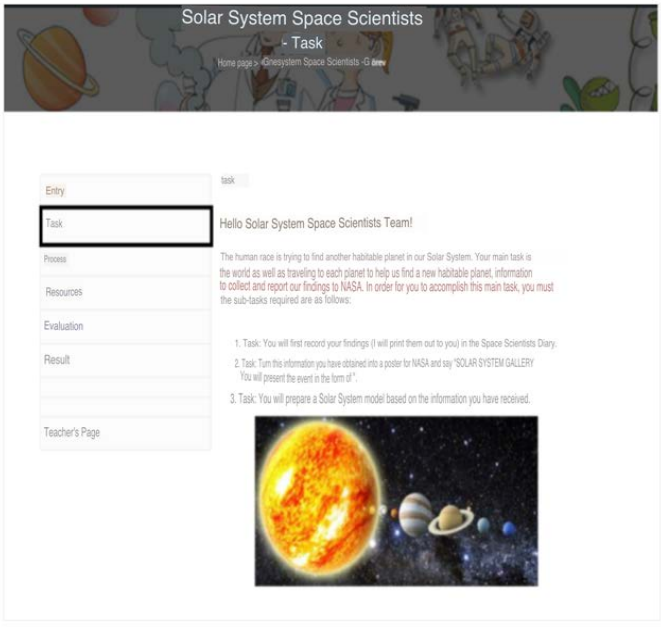
Appendix-1. WebQuest Sample Pages





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Science Education Needs of the Individuals with Intellectual Disabilities

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This study *was produced from* Cüneyt ÇAPRAZ's *doctoral thesis named "Teaching 'solid, liquid and gaseous 'states of some substances to students with intellectual disabilities studying in middle school special subclass using direct instruction method"*, conducted under the supervision of the late Prof. Dr. Ali Yıldırım.

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ABSTRACT

Science class is essential since it covers numerous daily life-related subjects; thus, every student should learn science topics effectively. This study aimed to determine the science education needs of students with intellectual disabilities. While identifying these needs, the study considered 'the teaching approach of some matters in solid-liquid-gaseous states' as the basis. It also followed the case study research design, one of the qualitative research approaches. The sample was identified by the purposive sampling method. Four students with intellectual disabilities enrolled in a special education class in a secondary school involved the teaching approach of some matters in solid-liquid-gaseous states. Researchers collected the data through interviews with three special education teachers and one science teacher and through in-class and out-of-class observations in a special education school and two secondary schools retaining special education classes. The collected data were analyzed using the content analysis method. As a result, this study identified both educational-teaching needs and needs for the educational-teaching environment of students with intellectual disabilities.

Keywords: Science education, intellectual disabilities, needs analysis, special education

Introduction

Intellectually disabled individuals may engage in social life to a limited extent. These individuals constitute a sizable proportion of individuals with special needs, and their participation in educational environments is increasing steadily. Hence, for these individuals to effectively participate in educational settings and receive satisfactory education, eliminating the difficulties they experience in accessing educational environments and social living spaces and satisfying their physical needs in educational environments is necessary (Ergün, 2005; Uşaklı, 2009). Indeed, it is crucial to take the required measures by considering education, training, and learning needs to ensure the efficacy and efficiency of the education provided (Yazıcı et al., 2021). The regulations and supports required by individuals with special needs are also similar to those without such needs (Ministry of National Education [MEB], 2006). Therefore, it is critical to identify the requirements of individuals who need special education for effective education.

Need recognition refers to determining a problem or deficiency encountered and selecting a systematic and logical solution to such cases (Kaufman & English, 1979; Witkin, 1994). Determination of education, teaching, and learning needs constitutes the first step in preparing an educational program. The process also involves setting fitting targets in line with the identified needs and includes the planning of the curricula in line with these targets, the teaching process based on the targets and content, and an evaluation process to specify to what extent these targets have been achieved (Karacaoğlu, 2009). Therefore, the need recognition process becomes critical and effective in determining the current educational status and how it should be (Şahin, 2006).

Both national and international laws and agreements include the right to education for individuals with special needs. With the contribution of these laws and agreements, the participation of these individuals in the education-training environment is growing every day. At every educational level, the United Nations Convention on the Rights of Persons with Disabilities (2008) ensures the inclusion of students with special needs in education and their right to education. The constitution of the Turkish Republic also retains similar guarantees. Article 42 of the constitution emphasizes that no student, including individuals with special needs, can be deprived of the right to education and training. Similarly, Article 15 of the Disability Law declares the necessity of including students with special needs in education by considering the types and levels of their disabilities, particularly emphasizing that nothing shall restrain these students from receiving education for any reason. As a result, these statements explicitly reveal the educational needs of these individuals.

Students with intellectual disabilities have similar learning goals to their peers without disabilities (Yazıcıoğlu & Kızılaslan, 2021). They can benefit from education in preschool and primary school classes. They also can learn to read and write in these classes and acquire some of the knowledge and skills they need in science and mathematics courses (Eripek, 2011; Tekinarslan, 2017). These newly acquired knowledge and skills will contribute to meeting the swiftly changing and developing scientific knowledge, rapidly advancing technology, and the increasing impact of science and technology on human life in this direction (Keşan & Kaya, 2008). It is impossible to disregard rapidly evolving scientific knowledge and technology independently of science since science education will enhance intellectual and creative skills (İşman et al., 2002). The educationally developed countries have reflected the concept of “science for individuals” in their educational curricula. For instance, the American National Research Center emphasizes that age, gender, culture or ethnicity, type, and level of disability variables are insignificant and that all students in the education system should receive equal science education (National Research Center [NRC], 1996). Correspondingly, the Turkish educational vision of all individuals to be scientifically literate has been adopted for science courses (MEB, 2018). These data explicitly suggest that individuals with intellectual disabilities should receive science education, and science education should be in the education-training programs of individuals with mental disabilities.

After determining the need for education and deciding how to provide these services, it is crucial to identify the needs in the environment and establish proper educational settings based on these needs to provide suitable education and enable students to progress in line with their interests, desires, skills, and their development attributes (Avcılar, 2010). While establishing these environments, it is also vital to pay attention to the suitableness of educational environments for science education/training and general teaching (Durmaz et al., 2022). Additionally, when establishing proper settings for science education, teachers should consider students' disparities and needs. In line with these disparities and needs, science teaching materials relevant to students' learning abilities, learning speeds, development levels, and types of disabilities should be prepared (MEB, 2005). Indeed, these individuals learn concrete concepts or subjects more easily than abstract ones (Mastropieri & Scruggs, 2015/2016; Tekinarslan, 2017). Yet, there should be laboratories available in science teaching environments for concrete learning because, among the science teaching methods used, the laboratory method is one of the most effective methods in terms of increasing success in students, solving problems, and developing a positive attitude toward science (Seven & Engin, 2018; Sıdal et al., 2023). Laboratories also play a crucial role in learning science topics or concepts meaningfully and ensuring learning permanency since these settings enable students to engage in activities based on doing and experiencing. Yet again, with laboratory practices, students put the learned information into practice, develop their manual skills, and learn to work and share together (Ayas, 2006; Kırpık & Engin, 2009). An educational environment organized based on student needs will be effective in terms of creating positive communication and interaction between these students and their peers (Avcılar, 2010).

In the context of learning needs, the Science Course Curriculum, which was prepared by taking into account the needs and mental development of individuals with intellectual disabilities, involved the learning topics, including matter and change, living things and life, physical phenomena, the world, and the universe (MEB, 2001). Raising scientifically literate students is the primary function of science education. Individuals should receive a science education based on their mental competence, taking into account their intellectual development (Kaptan, 1998). In his research on teaching science to individuals with intellectual disabilities, Mete (2016) determined that these individuals can learn some science topics and concepts, suggesting that such individuals potentially learn some science topics.

This study, therefore, aimed to determine the science education needs of students with intellectual disabilities. The study is valuable in terms of identifying the need to

prepare education and training curricula, establish learning settings in line with the needs of individuals with intellectual disabilities, and help teachers and practitioners how to make the necessary arrangements. Indeed, the educational settings designed based on these considerations will make individuals feel a sense of belonging and more valued in these environments. Within its parameters, in this context, the study addressed the following question: "What are the science education needs of students with intellectual disabilities?"

Methods

Research Model

The study followed the case study research design based on the qualitative research approach to make an in-depth description of the needs of students with intellectual disabilities for science education and making assessments. A case study method involves an in-depth analysis of an event, activity, process, or person (Cresswell, 2013).

Sample

The case study required an in-depth analysis of the intended research; thus, it used the purposive sampling method. Three (3) special education teachers (a female and two males) and one (1) male science teacher participated in the study. The teachers had at least seven years of experience. The observation part of the study involved one (1) special education school and two (2) secondary schools with special education classes located in the center of Erzurum province. The primary objective of studying different schools was to observe and identify needs in every possible educational environment where special education students can receive an education.

Data Collection Tools

Considering the validity of data collection, the study preferred interviews and observation techniques, which are widely used in qualitative research. The study also utilized a semi-structured teacher interview form developed by the researcher and unstructured observations in the data collection process to make detailed in-class and out-of-class observations. The interview form contained 12 open-ended and short-answer questions to determine the need for science education. After preparing the interview questions, two experts in chemistry education carefully examined the interview questions. The researcher updated the required questions based on the expert opinions and performed the interview form for the teachers. The teachers provided written responses to the interview questions. Consent was obtained from participants.

Data Analysis

The study used observation and interview data for content analysis, categorized under different themes, categories, and codes, and presented them in the result section (Table 1). Two experts jointly performed the tests to ensure the reliability of the data analysis. Accordingly, their analyses revealed over 80 percent of concordance. The study made a new configuration in the categories with differences and displayed the final analyses in the results section.

Results

The study analyzed the needs of the education and teaching environment and the educational needs of the students through unstructured in-school and in-class observations and semi-structured interviews conducted with three special education teachers and one science teacher. Table 1 summarizes the findings obtained from these observations and interviews.

Table 1.
Findings of Needs Analysis

Theme	Category	Code
Educational Environment Needs	Out-of-class Environment	Canteen, WC, corridor, classroom location, etc.
	Communication and interaction	Peers, teachers, and other staff, etc.
Teaching Needs	Material	Availability and accessibility of material, etc.
	Teacher	Communication, method, attitude, reinforcement, etc.
Learning Environment Needs	Items in the classroom	The properties of the items, height, shape, etc.
	Physical Environment	Location and position of items, location of materials, etc.
Learning Needs	Science Learning	Learning science topics and concepts.

As shown in Table 1, the analyses revealed four themes: educational environment needs, teaching needs, learning environment needs, and learning needs. Subsequently, the study determined the categories and codes for each theme and revealed the needs accordingly.

Findings of Educational Environment Analysis

Regarding the educational environment needs, the analyses identified the deficiencies related to out-of-class environments, communication, and interaction with peers and school personnel, in addition to the needs in areas such as the location of the classroom and the canteen. These findings are given below.

Out-of-class Environments

The educational environment is not only limited to the classroom but also involves in-school and out-of-school environments where students are out of classes and constitute the components of the education system. There was no essential equipment in the schoolyard, which is a critical place where students with intellectual disabilities can readily engage and communicate with their peers without disabilities. Thus, students with intellectual disabilities were unable to leave the classroom during break times and could not engage with their peers without disabilities. Additionally, the canteens, key locations that contribute to students' socialization, inclusion in daily life, and independence in meeting their needs, lacked the necessary arrangements. As a result, students with intellectual disabilities primarily relied on the meals (foods) they bring from home to meet their needs.

There were no essential arrangements inside the schools selected for the current study. Accordingly, the classrooms in both secondary schools were on the second floor, the staircases had no special arrangments, and there were no accessible walkways or elevators for students with intellectual disabilities. Additionally, the windows lacked an iron barrier, which would pose a risk when these individuals were alone in the classrooms. Finally, the disabled pathways outside the school were not empty and clean (vehicles, objects, snow, or other obstructions).

Communication and interactive relation

The non-disabled peers of the students, with whom they share their educational environments, communicate, and engage, were unaware and had insufficient knowledge of how to behave towards individuals with disabilities and how to assist them. Additionally, intellectually disabled students might be exposed to violence and similar misbehaviors by non-disabled students. The teachers at the school had observably insufficient knowledge about disabled students. Correspondingly, the cafeteria staff and other school employees lacked how to communicate with these individuals and how to behave towards them.

Findings of the Teaching Needs Analysis

One of the significant findings of the study was the scarcity of materials used in education and training or the difficulty of accessing them. The findings are summarized below.

Material

The educational settings where students with intellectual disabilities are taught lack sufficient educational and instructive materials. Teachers of special education students also lack the educational resources to make abstract concepts as concrete as possible in their education and encourage them to comprehend materials by seeing and touching them personally. Teacher #1 stated that *they exclusively experience material deficiencies and that the material design should be appropriate for teaching and improving teaching effectiveness*. In this context, teacher #1 indicated that *a shortage of materials and unsuitable settings adversely affect the education and teaching activities, limiting his capacity to execute the desired activities*. He additionally remarked that *the story cards, in particular, contain an intricate event pattern, and the cards related to the teaching topic are not properly prepared to describe ground-figure relations*.

Accordingly, the data findings regarding the material preparation and use based on in-class observations are as follows.

- Students should easily access smart cards, pictures, and real materials brought into the classroom environment for teaching for a set amount of time so that they can analyze them. Students should be able to examine and familiarize themselves with these materials.
- The design of the teaching materials should attract the attention and interest of the students to execute the activities desired. In this sense, the material itself or its picture displayed in the classroom should be visually well prepared. Indeed, the researcher observed that such materials were not designed and displayed properly.
- Student's disability level and type are critical issues to consider while preparing the educational material. For instance, if there is a student with low vision in the classroom, there should be worksheets prepared in large fonts, magnified visuals, and audio recordings to teach the course. Hence, this setting will ensure that the student will actively and effectively participate in the class.
- It is important to use course materials carefully, choosing items that students are familiar with, will encounter regularly, and utilize in their everyday lives to enable them to focus their attention on the course subject rather than the material.
- The size of the picture materials used in teaching critically affects students' learning. For instance, pictures that are at least 10x10 cm will have a

facilitating effect on the student's perception. The continually used picture cards should be glued onto hard cardboard and covered with PVC to prevent them from easy wear and tear.

Teacher

For special education teachers, it is essential to identify the deficiencies in terms of the effectiveness of teaching in the process and align them with the interests and needs of children with intellectual disabilities before and during the teaching process. Indeed, the teacher is an essential component of the teaching process. The issues outlined below are the findings based on in-class observations and interviews. As a result, special education teachers should pay utmost attention to these issues to meet the teaching needs while also ensuring the efficacy and success of the teaching process.

- Teachers must use clear, comprehensible language in the classroom without offending the students.
- Teachers must always exchange their views with school counselors, Provincial Guidance Research Centers, and special experts while identifying the interests and needs of the students, determining and using the methods and strategies they will implement in the classroom, and making potential adaptations in the classroom environment. Taking these issues into consideration will make education more effective.
- While teaching such individuals, teachers should not move on to another course topic or concept without teaching a topic or concept thoroughly. Otherwise, these individuals will fail to structure their knowledge and actualize an effective learning process.
- Beware of overdoing while giving concrete reinforcements to the students; instead, teachers should provide reinforcements in line with their interests and needs after determining them. Giving a reward that the student does not need would not serve as reinforcement.
- The course subject or unit should be made suitable for teaching by taking into account the purpose of the study and the characteristics of the student. Thus, a content analysis is necessary before teaching. With the content analysis, the content of the subject or unit should be recreated according to the mental level of the students.
- There should be a teaching plan developed for the course content.
- Teachers should pay utmost attention while planning the course and identify if there are students in the classroom with disabilities other than intellectual disabilities. If there is any such student, teachers should organize the teaching process by considering the disabilities of these students.

Learning Environment

Materials in Classroom

The observations made in the classroom environment resulted in unnecessary overstimulating items in the environment, an environment that was not simple enough, sharp corners of the inner and outer walls, doors, desks, blackboards, storage cabinets, coffee tables, etc. of the school, an unrounded classroom shape that might injure students, and uncarpeted floors lacking non-slip and sound-reducing carpets, etc., among other materials. Similarly, the desks, blackboards, storage cabinets, coffee tables, etc. were not fixed to the walls and floors to prevent students from falling on them and getting injured.

Physical Environment

The physical environment is one of the primary aspects of the arrangement of the educational setting. In this sense, the illumination design in the classroom was not in the form of avoiding distraction. The configuration, position, and height of student desks, teachers's desks, and blackboards were unadjustable. Electrical outlets were potentially dangerous for students and observably had no cover, or their locations were easily accessible by the students. Additionally, there were cutting and piercing tools such as scissors, knives, etc. carelessly kept open in areas where students could reach and inconsiderably accessible in secured cabinets. Students could readily reach these tools during breaks in the absence of teachers. Teacher #1 stated that *he could not always be with them since he was the only teacher in the classroom. He also indicated that students were left alone when they needed to take breaks and meet their special requirements, and eventually, some problems might arise during these times*. Briefly, teachers did not pay enough attention to arrange the educational setting in a way that develops the students' sense of belonging to the environment, makes them feel valued, and is minimally restricted. As a result, the arrangement of the classroom environment appeared to be without considering the individual competencies of students with intellectual disabilities and ignoring their self-confidence development.

Findings of Learning Needs Analysis

The study analyzed the science learning needs through semi-structured interviews with teachers and interviews conducted in schools and classrooms. Accordingly, teacher #2 stated that *students ought to learn some course subjects, such as solid-liquid-gaseous matters, certain disciplines included in the existing curriculum*. He

emphasized that *students with intellectual disabilities could also learn these topics if their content is prepared according to their level and supported with proper materials in the classroom*. Reiteratedly, special education teacher #2 underlined that *these individuals could learn certain science subjects*.

Considering the learning needs, special education teacher #1 stated that *choosing concrete course subjects is necessary for classroom discussions, and teaching should mainly involve laboratories*. As a result, special education settings must include laboratories for this purpose. Regarding the study about teaching some science-related subjects, teacher #1 also expressed that *students were very eager to learn the course subjects; they repeatedly asked him when they would study these topics again, and they were happy and enjoyed learning these science subjects*.
In summary, a school and classroom environment arranged in line with the science education findings presented in this result section will not only improve the effectiveness of science education but also help these students succeed academically in other courses and make progress in areas, including social skills and self-care.

Discussion, Conclusion, and Recommendations

This study aimed to determine the science teaching needs of individuals with intellectual disabilities. In line with the study findings, students' needs were categorized under the following four themes: educational environment needs, teaching needs, learning environment needs, and learning needs. The existence of the educational setting is the primary need. The study findings revealed that individuals with intellectual disabilities were unable to receive the necessary and satisfactory education. Furthermore, the content, objectives, teaching process, and evaluation process of education were not arranged based on the level and disability types of the students. Giving the necessary priority to educate such individuals is critical for them to survive independently in society and partake in daily life more successfully. The rights to education of individuals with special needs and their right to benefit from the educational services they are entitled to at the highest level are ensured by laws (National Education Fundamental Law No. 1739) and other legally binding statutory decrees (SD No. 573).

Regarding the need for science education and teaching, the special education teacher stated that the current curriculum involved the need for students to learn certain subjects, such as solid-liquid-gaseous matters. However, he explicitly underlined that the content of the course subjects should be adaptable to students' levels. Additionally, proper materials should support the lecture to provide an effective subject and content for science education. Studies in the literature also support this teacher's perspective as well. For instance, Mete (2016) taught some hard-soft matters to three students with intellectual disabilities and observed that two out of three students permanently learned the topic with the direct teaching method. Additionally, these two students were successful at the recall. The third student, on the other hand, failed to achieve permanent learning.

Based on the educational environment observations and interviews, the study revealed that the classroom and school environment were insufficient and unsuitable for teaching science to individuals with intellectual disabilities. A teacher pointed out numerous material deficiencies, indicating that the teaching materials should be proper and available in a manner that will increase the effectiveness of the teaching. Furthermore, he expressed that the lack of materials and improper educational environment would adversely affect teaching activities; thus, it would restrict his ability to provide desirable lecturing. As a result, the least restricted arrangement is best for educational settings (Çıkılı, 2013). In addition to effective education, the least restrictive educational environments will substantially affect the abilities of these individuals, establish and facilitate interactive relations and communication with their peers, and enable them to engage and develop friendships (Avcılar, 2010). Therefore, teachers should focus on arranging educational environments in a way that would develop students' sense of belonging to the environment and make them feel valuable (MEB, 2008; Tekinarslan, 2017). Another element to improve the effectiveness of education is to determine the educational needs and eliminate the deficiencies. Being aware of the needs and special cases of the students is critical for a successful education since designing an engaging and distraction-free educational environment is essential for increasing and sustaining the quality of teaching (Erişti et al., 2013). As a result, student behavior will directly benefit from a classroom environment that is structured with these factors in mind (Avcılar, 2010).

Individuals with special needs may also experience difficulties such as rejection and exposure to violence and similar misbehaviors by their peers. The success of these individuals, especially in inclusive practices, considerably relies on their ability to communicate effectively with their non-disabled peers and develop positive relationships and social acceptance. Environments, designed based on the mentioned issues, will positively contribute to students' active participation in daily life, their societal acceptance,

and the development of various aspects (Metin, 2012; Tekinarslan, 2017).

The study observations and interviews revealed that high-quality science teaching should meet certain requirements. The special education teacher also stated that science teaching should involve concrete subjects and underlined the significance of laboratories by expressing that laboratories are vital in special education environments. These findings are compatible with the research done with teachers from diverse branches (Balbağ & Karaer, 2016; Çınar, 2013; Demir et al., 2011; Geçer & Özel, 2012). Students' ability to learn effectively depends on opportunities that provide comprehensive and error-free learning. Erdem (2011) and Türer (2010) stated that developing a learning environment that will meet learning needs and provide the necessary opportunities will increase the success of students with intellectual disabilities. Correspondingly, Kasapoğlu, Duban, and Yüksel (2014) noted that student success will improve in properly organized educational environments.

The study findings revealed that a positive learning environment is necessary to improve educational quality. Hence, teachers are responsible for preparing learning environments based on student characteristics, needs, and the activities performed. Teachers should expectedly arrange materials to keep students engaged in the lesson, prepare the materials properly by considering the type and severity of student disability, and select the materials relevant to the subject matter and concept being taught, using materials that students come across and utilize frequently in their daily lives. Additionally, for the teaching to be effective and successful, teachers should use simple, clear, and comprehendible language without offending students, not overdo it while providing reinforcers, and give reinforcers accordingly by specifying the interests and needs of the students. They should also replan the subject and concept contents based on the intellectual level of the students, generate a content-related teaching plan in this direction, and avoid moving on to another subject or concept before teaching the previous one completely. In this context, Geçer and Özel (2012) reported that the lack of proper arrangement of physical environments and the absence or deficiency of teaching-related materials and equipment available cause teachers to experience difficulty performing activities in science and technology classes.

In light of the findings, this study underlines the following recommendations to meet the needs for science education provided to students with intellectual disabilities;

- Individuals with intellectual disabilities can learn certain daily life-related science course subjects in the presence of the necessary arrangements. Hence, it is possible to teach particular science course subjects to such individuals by determining the science-related subject they can learn and providing suitable settings for science applications in both special education classes and other educational environments.
- The materials used for individuals with special needs are of utmost significance since they pose diverse characteristics. Education and teaching materials developed based on each student's deficiencies will increase academic success. Hence, it is necessary to design materials that serve the individual characteristics of each student in science teaching.
- One of the key requirements that must be met in educational environments is to ensure the suitableness of an education and training environment. However, this study identified that the places of special lower divisions (masses) were unsuitable in schools, some in-school and out-of-school areas were insufficient in providing education and training for intellectually disabled individuals, and the security of these classes was insufficient enough for such individuals. Therefore, it is vital to determine the deficiencies and conduct studies to take the necessary measures by controlling the suitableness of in-school and out-of-school environments for individuals with special needs and providing the proper security conditions in educational environments for special education.

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A Systematic Literature Review of EFL/ESL Teachers' Emotional Experiences

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ABSTRACT

There is a growing body of literature regarding language teachers' emotions and their impact on teaching practices. However, the connection between their emotional experiences and their impact on teaching remains substantial. Evidently, integrative research methods are necessary to provide a more dynamic perspective on this complex subject. Thus, this study is based on the concept that emotions are complex and dynamic aspects of language teachers and learners during the learning and teaching stages. It is also motivated by the interest in conducting systematic literature reviews, the dynamic shift in language teaching, and the focus on a complex research phenomenon. On this basis, this study builds on 14 research articles conducted over the last ten years concerning teacher emotions. The study also used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis checklist. The findings suggest that further research is needed to explore the variation among language teachers' emotions in different contexts and their impact on teaching practice. This study also provides insights into professional identity, professional development, and fostering emotional connections between teachers and students.

Keywords: Language teachers' emotions, complex perspective, systematic literature review, professional development.

Introduction

The concept of emotion is complex due to a lack of consensus across psychological, historical, and sociological disciplines (Dewaele & Li, 2020, Fried et al., 2015; Li et. al., 2019). However, many educational scholars follow the description of Schutz et al. (2006) of emotion as "socially constructed, personally enacted ways of being that emerge from conscious and/or unconscious judgements regarding perceived successes at attaining goals or maintaining standards or beliefs during transactions as part of social-historical contexts" (p. 344). Farouk (2012) described teacher emotions as internalized processes that remain constant in the minds of teachers yet have a significant impact on their interactions with students, colleagues, and parents. The concept of teacher emotion involves combining internal and external experiences to capture teachers' feelings within social contexts. In this way, emotions have become an important part of individual and societal life.

In addition, emotions are critical in the learning and teaching processes (De Costa et al., 2018; White, 2018). Over the years, several scholars (e.g., Denzin, 1984; Frenzel et al., 2020; Richards, 2022; Sutton & Wheatley, 2003; Toraby & Modarresi, 2018) have attempted to define emotions from various perspectives. Based on the biological/structuralist viewpoint, for instance, emotions are considered innate human instincts, while cognitive studies describe emotions as individuals' interpretations of their surroundings (Oatley & Johnson-Laird, 2014). Within the poststructuralist/discursive framework, emotionality research has focused on individual identity and cultural contexts (Benesch, 2017). Early emotion studies tended to define emotions as abstract concepts obscured by their complex and dynamic nature (Agudo & Azzaro, 2018; Benesch, 2017). The emotionality of the classroom has emerged as an area of interest for many researchers, as emotion is central to the teaching process and contributes significantly to learning for both students and teachers (Dewaele, 2005; Hargreaves, 2000; Pekrun, 2006; Toraby & Modarresi, 2018).

Furthermore, language classrooms are emotional places where students and teachers incorporate their beliefs and values in teaching and learning languages (Shao et. al., 2019; Xu, 2013). To date, research on language teacher emotions has focused primarily on teacher anxiety (Reves &

Medgyes, 1994), burnout (Nagamine, 2018), and teacher emotion during times of reform. According to Barcelos and Aragão (2018), research on language emotions is still in early development. They examined the diversity of emotions experienced by Brazilian language teachers and how their beliefs interact with them. Based on their study, a systematic literature review should be conducted on language teachers' emotions and their influence on self-efficacy beliefs, classroom practices, and professional development. Although there has been much research on teacher emotions in several contexts, there is a noticeable absence of comprehensive studies investigating the emotions of language teachers and their influence on self-efficacy, classroom practices, and professional development in diverse educational settings. Therefore, this study provides a deeper understanding of language teachers' emotions in multiple contexts rather than focusing on a single context.

Methods

In response to the call for a dynamic and complex approach in the in the growing body of literature on language teachers' emotions (Agudo & Azzaro, 2018; Fried et al., 2015; King et. al., 2020; Toraby & Modarresi, 2018), the need to take a dynamic and complex perspective with integrative research methods is clearly emphasised. A substantial discrepancy exists between language teachers' emotional experiences and teaching practices. This study focuses on understanding emotions as complex and dynamic components in both instructional and learning contexts due to the large gap between language teachers' emotional experiences and how these emotions shift and to be heard in various settings and dimensions. This study considered emotions as complex and dynamic aspects of language teachers and learners in both learning and teaching. Briefly, our comprehensive literature review is driven by current paradigm changes in language education and the complexity of language instructors' emotions and their interactions with diverse instructional processes (Larsen-Freeman, 2013) and an interest in a complex phenomenon-language teachers' emotions and their interaction with other sub-systems in the teaching process. Various analytical techniques have been utilised in our review of the growing body of literature to analyse this burgeoning field of research. A systematic review of the literature was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Checklist (Moher et al., 2009). The first step in this process was to screen articles for relevance, specifically selecting those related to language teacher emotions, subsequently, 14 research articles were found to be related to language teacher emotions (see *Appendix A)*.

Specifically, during the study's first phase, research articles from several databases were analysed, such as ERIC, ResearchGate, and Google Scholar. The keywords used included: "teacher emotions", "language teacher emotions", "emotional challenges of language teachers", and "emotional experiences of language teachers". The last search was conducted in November 2023 with the first database search yielding 58 studies in the all database. To ensure the relevance of the studies to our specific research focus on English as a Foreign Language (EFL)/ English as a Second Language (ESL) teachers' emotions, we employed meticulous screening process. In screening the abstracts, we excluded 44 studies, while addressing teacher emotions, did not specifically pertain to emotional experiences of language teachers working as EFL/ESL teachers. In keeping with the study purpose, the remaining 14 research articles were thoroughly examined to determine whether they could answer the following research questions:

1) What are the emotions that EFL/ESL teachers experience in various contexts?

2) How do these emotions contribute to or affect their teaching performance/practice or career?

The elimination criteria for the study were developed based on the complexity of emotions. Consequently, quantitative studies were excluded from the dataset because they may approach this complex phenomenon too linearly. Even though the studies in this review do not explicitly take a complex dynamic approach, all of them are grounded in nature. This study draws upon 14 studies on language teacher emotions conducted within the last decade to have a more complex understanding about the research concept.

Results

Following the screening process and eligibility assessment, 14 studies were ultimately identified for use in the present study. One study met the criteria with participants that taught various languages (Deng et al., 2018). This may affect the emotions the study uncovers, considering that education in different languages might involve different emotional experiences. The findings revealed that most of the studies were longitudinal and focused on the emergent, multi-component, and evolving nature of emotions. Additionally, all these studies mentioned the importance of the context in which language teachers work. The teachers practised in various cultural contexts, including in Spain, Mexico, the United Kingdom, the United States, Greece, Japan, China, and Finland. This finding is in line with Ushioda's (2009) persons-in-context perspective, which highlights context-dependent emotions. Interestingly, most studies, 10 out of 14, focused on experienced language

teachers (Acheson et al., 2016; Benesch, 2020; Cowie, 2011; Cuéllar & Oxford, 2018; Edward & Burns, 2020; Gkonou & Miller, 2020; Karragianni & Papefthymipu-Lytra, 2018; Xu, 2013). However, some included pre-service (Agudo & Azzaro, 2018; Lui & Yuan, 2023: Méndez-López, 2020) and novice teachers (Arizmendi Tejeda et al., 2016).

A variety of data collection instruments were used in these studies, including in-depth interviews (Agudo & Azzaro, 2018; Benesch, 2020; Cowie, 2011; Méndez-López, 2020; Ruohotie-Lyhty et al., 2018), self-reports (Agudo & Azzaro, 2018), reflection journals (Méndez-López, 2020; Xu, 2013), classroom observations (Méndez-López, 2020), teacher narratives (Acheson et al., 2016; Gkonou & Miller, 2020), and field notes (Xu, 2013). Most studies used semi-structured interviews and teacher narratives; however, two studies utilised both surveys and interviews (Agudo & Azzaro, 2018; Karragianni & Papaefthymipu-Lytra, 2018). Fourteen studies that met the eligibility criteria were coded through content analysis. The overview of the related findings is presented in the Table 1 below. Moreover, the following section thoroughly explains the findings of the study and the emergent codes.

Table 1.
Overview of Findings

Participants	Research Methods/ Instruments	Emerged Themes	
Pre-service-Teachers (n=3)	Interview (semi-structured/ structured) (n=12)	**Emerged Emotions**	**Emotional Experiences**
Novice Teacher (n=1)	Narrative (n=4)	*Positive Emotions*	Emphasized on emotional interaction with students (n=3)
Mid-career/ Experienced Teachers (n=10)	Self-reflection/ Journals/reports (n=4)	Happiness, Joy, Satisfaction	Lack of support from colleagues/institution (n=2)
	Questionnaire (n=1)	*Negative emotions*	
		Burnout, Frustration, Insecurity	Change and shifting emotions (e.g. from anger to empathy)

Emotions Experienced by EFL/ESL Teachers in Diverse Contexts

Based on the results of the present study, it was concluded that EFL/ESL teachers experience diverse emotions in various contexts. Most articles discussed the emotional experiences of language teachers in relation to their students, colleagues, institutions, and emotional labour. For instance, the study conducted by Cowie (2011) examined the emotional experiences of nine experienced Japanese university teachers related to their students, colleagues, and work to understand the effect of these emotions on their lives. The study utilised a socio-constructivist approach to situate language teachers in their context and understand the meaning and emotions associated with it. Furthermore, the study revealed a variety of emotions concerning students. These included warmth, anger, encouragement, satisfaction, respect, collegiality, and lack of trust and support in their institution.

Another study on the emotional experiences of 15 pre-service teachers and the characteristics of their teaching practice focused on the emotional interactions of teachers with students, supervisors, and materials (Méndez-López, 2020). According to this study, negative emotions, such as despair, insecurity, frustration, and stress, dominated the practicum process. To further explore the effects of these incidents, Gkonou and Miller (2020) conducted a study of 13 English teachers' emotional experiences. Their study revealed that participants had a range of emotional characteristics, including understanding students' behaviour, interpersonal resilience, and emotional triumphs. Similarly, Xu (2013) studied the emotional experiences of three Chinese language teachers in relation to students, colleagues, parents, and administrators using emotional geographies and various data collection methods. The study suggested mixed emotional characteristics, such as mutual regard and anger with students, respect and concern about their colleagues, and empathy and acceptance with administrators. Cuellar and Oxford (2018) conducted a narrative study to explore the emotional experiences of one teacher. According to their study, the teacher reported high satisfaction, enthusiasm, and passion for students.

In another study focusing on the shifting emotional experiences of seven EFL teachers in Finland, Ruhoties-Lyty et al. (2016) investigated the teacher-student emotional relationship. During the early stages of their career, negative emotions such as anger and disappointment were characteristic. Conversely, the following years were characterised by a positive change in their emotions towards their students. This was suggested to be a consequence of their experiences. Additionally, Arizmendi Tejeda et al., (2016) examined five novice teachers' negative emotions and the use of self-regulation through interviews and field notes rather than focusing on experienced

teachers. Due to the student's disruptive behaviour, novice teachers reported feeling nervous, angry, and frustrated. Using a mixed-methods approach, Agudo and Azzaro (2018) explored what triggered the emotions experienced by 30 student teachers during their practicum and the challenges they faced during that period. This study reported various positive and negative emotions, including enjoyment-the most frequently expressed emotion-happiness, enthusiasm, satisfaction, and love. On the other hand, anxiety and insecurity were the most commonly mentioned negative emotions.

In contrast, Benesch (2020) focused on the diverse emotional aspects of the five language teachers' emotional experiences, identifying contradictory feelings. Through discourse analysis, Benesch (2020) suggested that emergent emotions result from inevitability, unfairness, and injustice concerning language teachers. Another study conducted by Acheson et al., (2016) examined the emotional labour of five language teachers. It revealed participants' emotional experiences related to the lack of support they received from their community concerning learning foreign languages; they were under emotional pressure and sought to motivate their students.

Karragianni and Papaefthymipu-Lytra (2018) conducted a study examining the emotions of four EFL language teachers regarding the sustainability of teacher development. The teachers reported feelings of excitement, joy, satisfaction, anxiety, frustration, shame, and helplessness. Edwards and Burns (2020) drew attention to the dynamic emotional experiences of five ESL teachers during their action research. Throughout their study, participants reported a variety of emotions during the research's three phases: (1) during the research-feeling overwhelmed but also euphoric; (2) upon completing the research-feeling humble, revitalised, and energised; and (3) in the aftermath of the research-feeling restricted, re-energised, anxious, and frustrated.

Overall, the studies on language teachers' emotions demonstrated the importance of each study, participant, and particular setting which highlighted the importance of the ecological perspective on emotions, as it emphasises the importance of making sense of emotions within context. People are considered human beings with identities, histories, and individuality (Cuéllar & Oxford, 2018; Ushioda, 2009). From a complex dynamic systems perspective, most studies examined nestedness, uniqueness, and emotions' interactions with other systems, such as students, parents, and colleagues (Agudo & Azzaro, 2018). In another study conducted by Pham and Phan (2023), the significance of context and comprehending teachers' emotions within their cultural context were also highlighted in the findings, as the reported teacher emotions were related to Vietnamese culture. There appears to be heterogeneity among the studies regarding the emotions that emerged in each study; however, the codes report emotions in different terms and conditions with respect to different contexts. As emotions are context-dependent, the emotions that emerge from the study cannot be generalised.

In light of the related literature, it is of utmost importance not to label emotions as abstract products of the working mind but also to consider what these emotions "do" socially (Ahmed, 2004, as cited in Benesch, 2017). The gathered data were analysed within the scope of this study to ascertain what those emotions meant or what they contributed to those teachers.

Contributions of Language Teacher Emotions

According to studies on language teachers' emotions, the findings of the current study indicated that different factors contribute to or affect teacher emotions. For example, in the study of Agudo and Azzaro (2018), the emergent emotions of pre-service teachers have a variety of interpretations for future research. Pre-service teachers conducting their practicum felt insecure and frightened because of their lack of teaching experience and constant monitoring by supervisors. Furthermore, positive emotions suggest that students' emotions and the need to feel respected are important. Another study (Méndez-López, 2020) in which pre-service teachers encountered unexpected classroom situations revealed survival strategies emerging from their emotions. Emotions contribute to pre-service teachers reshaping their professional identities by exposing them to classroom realities. As Méndez-López (2020) described, negative emotions among pre-service teachers affect their teaching performance. Additionally, in the study conducted by Liu and Yuan (2023) it was also revealed that pre-service teachers reported emotions that vary from nervousness to joy which highlighted need for exploration of emotional journeys of pre-service teachers in different contexts.

Arizmendi Tejeda et al. (2016) studied novice teachers to determine the impact of emotions on professional identity. This study highlights the impact of emotional regulation on professional identity and the lack of self-confidence that they experience due to negative emotions; novice teachers sometimes prefer to modify emotional experiences and expressions. In contrast, a study of teachers' emotional experiences regarding their colleagues, students, and administrators revealed the importance of collaboration, emotional conversations, and encouraging emotional connections between students and teachers (Cowie, 2011). The study also highlighted that teachers' emotions and professional identity are intertwined, as they expressed a

desire to engage with the students and act as moral guides for them.

Acheson et al. (2016) examined the emotional experiences of language teachers from another perspective and stressed the importance of teachers' emotions in terms of their emotional labour. One significant function of language teacher emotions emerged from a study by Benesch (2020), which revealed the importance of the political function of teacher emotions. According to the study, teachers constantly need involvement, as the teachers feel that the student exams are unfair. Similarly, Xu (2013) highlighted the importance of a mutual emotional understanding between teachers and learners by arguing that political geographies of emotions influence teachers' emotions in terms of ecological and moral landscapes.

Acheson et al. (2016) investigated the influence of teachers' beliefs on emotional labour. Their study examined how teachers' perceptions of what happens in their classrooms influence their beliefs about their own self-efficacy; the teachers reported a lack of institutional support and a burden resulting from their lack of motivation. This study suggests that teachers' beliefs are shaped by their emotions which are subsequently shaped by their beliefs. Conversely, an emerging aspect of teacher emotions within the scope of this review is the professional development of language teachers (Edwards & Burns, 2020; Karragianni & Papaefthymipu-Lytra, 2018). The results of these studies indicated that teachers' emotions are fluid, changing, and complex. Teachers included in two studies reported negative emotions relating to students (Karragianni & Papaefthymipu-Lytra, 2018) and their participation in action research (Edwards & Burns, 2020). Both studies emphasise the importance of professional development, as teachers benefit from critical reflection to improve their teaching (Karragianni & Papaefthymipu- Lytra, 2018) and from action research to enhance their practice (Edwards & Burns, 2020).

In their study Cuéllar and Oxford (2018) emphasised that teacher emotions evolve. Their study on Lila, an experienced language teacher, indicated that she thrived through her past experiences using emotional strength, beginning when she was a novice teacher and throughout her teaching career. Additionally, the study highlighted the importance of sharing and understanding in the classroom. Classrooms should be seen as a space where teachers and learners can express their feelings, resulting in mutual benefit, as in Lila's case. Gkonou and Miller (2020) discussed the benefits of critical events experienced by teachers and the need for emotional self-reflection. Another study also highlighted the evolving nature of teacher emotions and the effect of experience. Ruohotie-Lyhty et al. (2018) reported that teachers' negative emotions related to students' behaviours changed and evolved throughout their careers.

The increased interest in language instructors' emotions as complex, dynamic, and evolving aspects of teachers' ecology is a key focus of this systematic literature review. All the studies focused on the notion that emotion is a complex research phenomenon that needs to be incorporated into education programs. Furthermore, teachers must cultivate emotional intelligence and regulation (King et al., 2020). In other words, most studies have highlighted the significance of language teachers' emotional intelligence (Cuéllar & Oxford, 2020; King et al., 2020). Thus, emotionally competent teachers may benefit from understanding how to act or "even thrive in emotionally challenging situations" (King et al., 2020, p.290). In addition, the current study demonstrates the context-dependency of teachers' emotions and their uniqueness among the reviewed studies as 'they do not appear in a vacuum' (Madalińska-Michalak & Bavli, 2018, p. 406). Another key finding of this review is the importance and value of teacher-student emotionality in affecting teachers' motivation, self-confidence, and self-efficacy (Karragianni & Papaefthymipu-Lytra, 2018; Méndez López, 2019; Ruohotie-Lyhty et al., 2018; Xu, 2013).

This study also highlights the need for further empirical research in this rapidly growing field to enable investigation into the diversity of language teachers' emotional experiences while emphasising the individuality of their experiences. By gaining a deeper understanding of the complex, dynamic, and evolving nature of emotions (Fried et al., 2015), we may be able to reshape and support the language teacher education curriculum. It is also worthwhile to consider the implications and effects of emotions as they pertain to ecology—including students, parents, colleagues, and institutions—to illustrate how emotions, cognition, and behaviour are interconnected and influence teaching (King & Ny, 2018).

In this study, a greater variety of academic publications have been integrated, including articles and books, that build upon the earlier research. This review also highlighted a variety of data collection instruments that have been used, yet the results are limited in several ways. Although researchers have attempted to include all relevant studies, some may have been overlooked. Future research should include a variety of journals and books to address these limitations.

Conclusion, Discussion and Recommendations

This study presents a systematic literature review of language teachers' emotional experiences. The findings of this study may contribute to the growing body of literature on language teachers' emotions. There is a need for further

research to understand this study's implications and results in creating variability in language teachers' emotions within different contexts and their contributions to teaching practices. The study revealed that, while teachers' emotions cannot be generalised and adopted in other research, they may provide insights into professional identity and development and facilitate emotional sharing between teachers and students. Furthermore, the study identified the importance of collaboration between colleagues and institutional support as critical factors of teacher support.

This study explored the emotions that emerged in various studies to better understand language teachers' reported emotions. The results highlight the uniqueness, individuality, and complexity of language teachers' emotions while keeping in mind that generalisation may be impossible due to context dependence. This study offers significant value in exploring individual human experiences and emotions in the context of their lives, as indicated by Ushioda (2009). Some studies indicated that teachers might also use negative emotions to improve their teaching practices. The contributions of teacher emotions were also evaluated. It was found that emotions contributed to professional development, self-confidence, motivation, and reshaping professional identities. Finally, although none of the reviewed studies explicitly favoured it, this study provides more insight into the complex dynamic systems methodology and teacher emotions.

The present study has enabled us to focus on and gain a deeper understanding of language teachers' emotions. A broader systematic review of language teachers' emotions may be achieved by asking research questions incorporating complex dynamic systems theory (Hiver & Al-Hoorie, 2019). Additionally, the heterogeneity of the methodologies limited our study. A further study could be conducted reviewing a variety of research designs on language teacher emotions. Moreover, this study encourages further research on language teachers' emotions based on the concept of complex dynamic systems.

Ethics Committee Approval: This study, using systematic literature review as its research method, does not require ethical approval.
Informed Consent: This study is based on publicly available data from previously published studies, informed consent was not required.
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** The references of the studies included in the systematic literature review have been marked.*

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Appendix A

No	Author/ Year	Study	Participants/ Context	Phenomena of Interest	Design/ Methods	Relevant Findings
1	Agudo & Azzarro (2018)	Emotions in Learning to Teach EFL in the Practicum Setting: Facing the Emotional Dilemmas and Challenges Associated with Professional Practice	30 EFL Student Teachers in a Spanish University	Emotions experienced by EFL student teachers in learning to teach in the practicum setting as well as the triggers for such emotions	Quantitative (using TES scale) and qualitative (self-report observations	Quantitative: enjoyment was the most salient, feeling happiness and enthusiasm, having fun most reported positive ones are satisfaction, enjoyment, as well as love and affection while most negative ones are insecurity, anxiety. Qualitative: feeling joy, happiness and passion for teaching, feeling satisfied with their work,
2	Acheson et al. (2016)	The Burnout Spiral: The Emotion Labor of Five Rural U.S. Foreign Language Teachers	5 rural foreign language teachers	The emotional work of five U.S. FL teachers	Qualitative (semi-structured interviews that involved narratives	The study revealed lack of community and institutional support, the excessive burden for motivation felt, the use of teacher emotion labour to motivate their students, emotional burnout, lack of self-efficacy
3	Benesch (2020)	Emotions and activism ELT teachers' emotion labour as responses to institutional power	15 instructors	Extended example of emotion labour as conflict between teachers' professional training/beliefs and institutional policies.	Qualitative (in-depth interviews)	Emotion expression of contradictory feelings & allusions to power or resistance to power then she continued with discourse analysis 1. discourse of inevitability 2. discourse of unfairness 3. discourse of injustice
4	Cowie (2011)	Emotions that experienced by EFL teachers about students, their colleagues and their work	9 experienced long-term career teachers working in Japanese University	Examines what contribution emotions make in the professional lives of experienced EFL teachers and to see what the field can learn for fostering teacher development	Qualitative Socio-constructivist approach Three interviews	There are variety of emerged emotions in every layer of the context. 4.1 Related to colleagues: satisfaction, respect, collegiality, 4.2. related to institutions: negative, perceived lack of trust 4.3. related to professional network: lack of institutional support, emotional support 4.4. related to warmth of sts: maintaining rapport w/sts
5	Mendez Lopez (2020)	Emotions attributions of pre-service ELT teachers and their effect on teaching practice	8 female 7 male pre-service teachers in Mexico	Emotions originated from the interactions of pre-service teachers with students, materials, and supervisors are analysed to understand to what they attribute those emotions	Qualitative (classroom observation, pre-service teachers' reflection journals, semi-structured interviews)	The most frequent positive emotions experienced were joy, happiness, and satisfaction and the most frequent negative emotions were despair, insecurity, frustration, worry, and stress *Three major themes: (a) Students' Behaviour and attitudes, (b)Undeveloped teaching skills, (c)Beliefs about teaching and learning
6	Ruhoties-Lyty et. al (2018)	Seeking Understanding of Foreign language Teachers' Emotions in Relation to Pupils	Seven EFL Teachers in Finland	Emotion to signify the importance of a relationship for teachers, as well as an indicator of the way in which teachers make sense of and orient to teacher-pupil relationships	Qualitative Narrative approach Dialogical perspective of Bakhtin -in depth interviews	negative emotions in the early years of their teaching career including anger and disappointment mixed emotions: varying emotions one time they are happy next sad positive and negative emotions experienced at the same time positive emotions: in the following years of their career, students' positive emotions brought positive emotions change in emotions: positive e. change derived from experience
7	Arizmendi Tejeda et al. (2018)	How Novice EFL Teachers Regulate Their Negative Emotions	Five novice teachers in Mexico	How novice teachers' emotions affect them and how to regulate those emotions	Qualitative Semi-structured interviews Field notes Micro and comparative	nervous because lack of self confidence anger or frustration, disruptive behaviours * Selection of situation- they prefer working with children *Cognitive change empathy rather than anger * Modification of emotional experience *Modification of emotional express

					analysis	
8	Xu (2013)	Language teacher emotion and relationships: A multiple case study	Three teachers in China	Emotional experiences in relations with students, colleagues, parents and administrators through emotional geographies	Qualitative Longitudinal study Narrative Inquiry Two semi-structured interviews Self-reflecting journals	e' interaction with students: 1. Mutual love 2. anger towards sts 3. bonding on twitter e's interaction with their colleagues: 1. respect for mentor, 2. worry over possible jealousy e's interaction with parents: mixed emotions, irritated E's administrators' empathy& accepting the suggestions ****moral closeness *political distances, * Physical distances
9	Karragianni & Papaefthymipu- Lytra (2018)	EFL Teachers emotions: The Driving Force of Sustainable Force of Teacher Development	4 EFL teacher who are working in Greece	Examines whether teachers' emotions maintain sustainability of teacher development and how this is realized	Quantitative (Achievement EmotionsQuestionnaire) Qualitative: interviews structured interview	* Excitement, joy, pleasure, satisfaction **pride ***anxiety, frustration, shame, helplessness. ****guilt. Negative emotions trigger critical reflection skills* they coined the term cognitive emotionality: which is being aware of manifestations of emotions not to regulate but in relation to professional development
10	Cuellar & Oxford (2018)	Teacher Emotions: Emerging From the Shadows	One case	Analyse the emotions personally experienced and described by a language teacher	Qualitative: Narratives	Growing emotional strength Joy, courage, love The teacher-student mutuality of emotional influence richly enhanced the classroom climate, the quality of language learning, and the lives of all involved
11	Gkonou & Miller (2020)	Critical Incident in Language Teacher Narrative Their emotional Experiences	13 English Teachers in UK and USA	Emotions related to past critical incidents and effect of these incidents	Qualitative: Semi-structured interviews	Emotionally charged discourse in T. Critical incidents from emotionally charged situations to emotional victories dealing with challenging students understanding students' behaviours and emotions not taking it personally experiencing emotional rewards *****self-reflection & potential change **** emotional turmoil to emotional reward
12	Edwards & Burns (2020)	'Opening Pandoras Box: Language teachers Dynamic Emotional Experience of Conduction Action Research	Five ESL Teachers	In-service ESL teachers' emotional experiences when conducting action research and impact on their identity	Qualitative Five in-depth interviews	During A.R: feeling overwhelmed & euphoric (opening Pandora's box) The end of AR: feeling humble of awakened/energized After A.R: feeling restricted or re-energised and anxiety and frustrations.
13	Pham & Phan (2021)	"Let's accept it": Vietnamese university language teachers' emotion in online synchronous teaching in response to COVID-19	Seven EFL Teachers	Emotional orientations and emotional responses of language teachers during the Covid-19	Qualitative Semi-structured interviews	Frustration, confusion, exhaustion Lack of St-T emotional interaction (given the context)
14	Liu & Yuan (2023)	Probing pre-service language teachers' emotional experiences through lesson study: a Macau study	Seven pre-service teachers (EFL)	Emotional experiences of pre-service teachers	Qualitative Interviews Written reflections	Nervousness, stress, excitement Joy, panic, amazement, anger *Supporting environment

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A Systematic Review of the Studies on WebQuest: Reflections to Mathematics

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ABSTRACT

The aim of this study is to determine the general trends of the studies on WebQuest in the field of mathematics education. This systematic review was conducted on 46 published studies from the beginning until 2023. The results after thematic analysis were presented through frequency and percentage values, tables and graphs. According to the results of the research, the first study on WebQuest in the field of mathematics education belongs to 2001. Half of the studies were published after 2014. It was concluded that the majority of the studies examined were in English and article type, the effect of WebQuest on academic achievement and the opinions on WebQuest were mostly examined. It was determined that the WebQuests prepared within the scope of the studies were on geometry and measurement. Methodologically, while the majority of the studies were prepared with a quantitative approach, adopting an experimental design, scales were used to collect data and inferential analysis for analysing, purposive sampling method was preferred in the selection of participants, and the participants were frequently composed of pre-service teachers. From the results related to the distribution of research topics according to sample types; it was determined that there was no study on the effect of WebQuest on the academic achievement of primary school students, the studies investigating the attitude towards mathematics and the effect of motivation were carried out only with secondary school students. At the end of the study, the benefits and limitations of WebQuest in the field of mathematics education were revealed.

Keywords: Webquests, mathematics, education, systematic review

Introduction

Technology's acceleration of globalization and digitalization has resulted in a change in the competencies required for individuals to be successful in their personal and professional lives. To adapt to these changes, it's crucial to have the necessary skills. The 21st century skills are constantly being updated with technological developments, but their characteristics include creativity, flexibility, adaptability to changing conditions, effective problem-solving, critical thinking, cooperation, and effective communication. In the information age, the search for skilled personnel has led to a shift in educational paradigms. WebQuests are an specialized web-based learning activity designed to promote research, inquiry, collaboration, critical thinking, creative problem-solving, information literacy, and communication skills. Developing 21st-century skills can be achieved through these teaching strategies (Bayram et al., 2019; Faraniza, 2021; Levin-Goldberg, 2014; Polly & Ausband, 2009).

WebQuest, created by Bernie Dodge in 1995, is defined as an inquiry-oriented activity where students interact with information from the Internet, optionally supported by video conferencing (Dodge, 1997). WebQuest, which is based on the theoretical foundations of constructivism, cooperative learning, scaffolding and fading model (Crawford & Brown, 2002), is an effective method that helps students acquire new knowledge as a guide in the learning environment and organises irregular Internet resources (Patterson & Pipkin, 2001). It has become popular (Lipscomb, 2003) due to its numerous benefits, such as enhancing individuals' motivation, supporting their problem-solving skills (Shang et al., 2015), providing a multifaceted perspective that requires high-level thinking skills (Fiedler, 2002), and contributing to the development of personal expertise (March, 2003). According to March (2007), WebQuests are becoming popular among educators for their ability to engage students in motivating activities that promote critical thinking. As a matter of fact, studies on WebQuest in Web of Science (WOS), which enables researchers to access the most relevant and prestigious publications, show that it has remained popular for about 30 years (Figure 1).

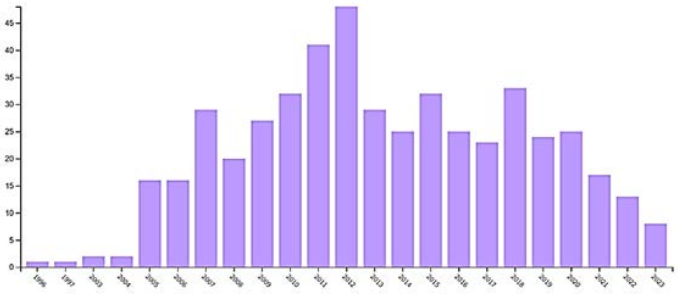

Figure 1.
Distribution of studies on webquest by years (WoS database)

Since 2004, there has been an increase in the number of studies on WebQuest from the Scopus database as depicted by the distribution of studies by year in Figure 2.

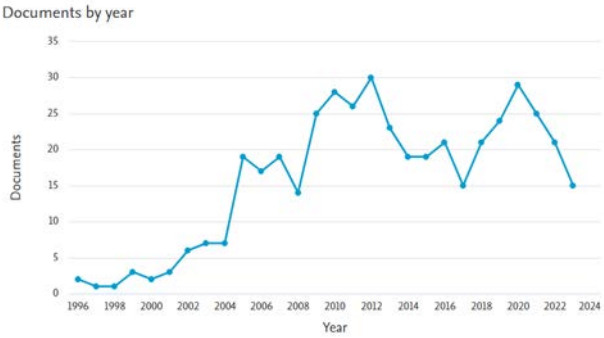

Figure 2.
Distribution of studies on webquest by years (Scopus database)

Changes in educational paradigms since the emergence of WebQuest have enabled the development of WebQuest. An examination of recent studies on WebQuests shows that Web 2.0, which has been heralded as a renaissance for WebQuests, has introduced designs for the combined use of Web 2.0 and WebQuests to increase their effectiveness (Cherner & Kokopeli, 2018; Dell, 2012; Kurt, 2009; Kurt, 2010a; Kurt, 2010b; Levin-Goldberg, 2012; Lin, 2011; Lin & Ward, 2013; March, 2007; Papadopoulou, 2012). WebQuests, which were developed for the effective use of the internet, which is called ill-structured (March, 2007), have turned into WebQuest 2.0 (Dell, 2012; Papadopoulou, 2012) and Web2Quest (Kurt, 2009; Kurt, 2010b; Lin, 2011; Lin & Ward, 2013) with the enrichment of the internet with Web 2.0 tools such as social networking sites, blogs, wikis and podcasts (March, 2007). Another innovation in education is STEM education. Science, Technology, Engineering and Mathematics (STEM) education has recently become a focus of educators. The results of studies combining STEM education and WebQuest (Alias et al., 2014; Chai et al., 2020), show that WebQuest is widely and effectively used in STEM classrooms (Alias et al., 2014; Osman & Saat, 2014). The effectiveness of WebQuest applications in flipped classrooms, which bring a different perspective to learning by turning traditional classrooms inside out (Abdelghafar et al., 2022; Abdelghafar et al., 2023; Nami, 2022; Pongsawat & Jeerungsuwan, 2015; Samiei & Ebadi, 2021) shows the importance of WebQuests for learning environments.

In the literature, there are different meta-analysis, meta-synthesis, content analysis and systematic literature review studies that examine the trend of studies on Webquest from past to present. The characteristics of these studies can be seen in Table 1:

Table 1.
Review studies on WebQuest in the literature

Author	Content of the Study
Kabadayı et al. (2023)	*Method* * Mixed research synthesis * Meta-analysis for quantitative study results * Thematic synthesis for qualitative study results *Year Range of Included Studies* * 2008-2020 *Number of Studies Included* * 12 quantitative, 11 qualitative studies, 23 studies in total *Keywords Used in Identification of Included Studies* * WebQuest, WebQuest and Achievement, WebQuest and Learning, Effect of WebQuest *also in Turkish language: Ağ araştırması, ağ araştırması ve başarı, Ağ Araştırması ve Öğrenme, Ağ Araştırmasının Etkisi, Web Macerası, Web Sorgusu

Bilir (2023)	*Method* * Content Analysis * Thematic Content Analysis *Year Range of Included Studies* * 2007-2022 *Number of Included Studies* * 21 master thesis, 6 doctoral thesis, 16 articles and 3 papers, total 46 studies (in Türkiye) *Keywords Used in Identification the Included Studies* * WebQuest * In Turkish language: Ağ araştırması, Web macerası
Khairunnisa (2021)	*Method* * Systematic Literature Review *Year Range of Included Studies* * all years *Number of Included Studies* * 28 studies (in ELT) *Keywords Used in Identification the Included Studies* * use of Webquest+ webquest as learning media+ the implementation of+ Webquest+ on ELT in seven major journal databases: Taylor and Francis, Springer, Science Direct, Sage, Academic, Emerald, Wiley Online Library
Alias et al. (2013)	*Method* * Content Analysis *Year Range of Included Studies* * 2005-2012 *Number of Included Studies* * 13 studies *Keywords Used in Identification the Included Studies* * The studies on WebQuest published in Educational Technology Research and Development (ETRD), Turkish Online Journal of Education and Technology (TOJET), The Educational Technology and Society Journal (ETS), The Learning and Instruction Journal (L&I), Australasian Journal of Educational Technology (AET), British Journal of Educational Technology (BET), Computer & Education (C&E)
Abbitt & Ophus (2008)	*Method* * Content analysis * Thematic content analysis *Year Range of Included Studies* * All years *Number of Included Studies* * 58 papers, 44 articles, 2 research reports, 2 web pages, 2 theses, total 108 studies *Keywords Used in Identification the Included Studies* * "WebQuest" and "Web Quest" in databases: Educational Resources Information Center (ERIC), EBSCO Academic Search Premier, Educational Research Complete, the Education and Information Technology (ED/IT) digital library, the Ohio Library and Information Network (OhioLINK), Google Scholar

Table 1 shows that studies on WebQuest have been compiled using content analysis (Abbitt & Ophus, 2008; Alias et al., 2013; Bilir, 2023), systematic literature review (Khairunnisa, 2021) and mixed research synthesis (Kabadayı et al., 2023). In addition to the studies listed in the table, Kurt (2012) attempted to identify the principles of cognitive load theory, interactivity, accessibility, usability, and visual appearance that should underpin an effective WebQuest design. Aydın (2016) conducted a literature review of WebQuest to assist teachers in their foreign language teaching activities and to provide a basis for further research on the subject. The problem-solving nature of WebQuest activities makes them a suitable way to teach mathematics (Crawford & Brown, 2002). Therefore, it is important to identify the general tendencies of any approach, method or technique, as well as its field-specific tendencies, to guide field-specific studies and future research. In this respect, this study is thought to be important in terms of highlighting the current state of the field and identifying trends for researchers. Unlike other studies, this study attempted to identify the general trends in studies of WebQuest in mathematics education. In addition, it is intended to contribute to the field by examining the research topics focused on in the studies with which sample groups and the benefits and limitations of the results in the reviewed studies in the context of mathematics education. The main target of this research is

to present problems not investigated in the literature to mathematics educators who will study on WebQuest.

This study aims to contribute to the literature by compiling existing studies on WebQuest in mathematics education. The objective is to identify trends of the WebQuest instructional strategy in the field of mathematics education related to WebQuest. In line with the research objective, answers were sought to the following sub-problems:

1. What are the characteristics of the studies conducted on WebQuest in the field of mathematics education in terms of demographic information?
2. What are the characteristics of the studies conducted on WebQuest in terms of content?
3. What are the characteristics of the studies conducted on WebQuest in terms of methodology?
4. What are the results obtained in the studies conducted on WebQuest in the field of mathematics education?

Methods

In this study, the systematic review method was adopted since it was aimed to determine the general trends of the studies on WebQuest in the field of mathematics education and to make inferences from the general results in the literature and to reveal the gaps by analysing and interpreting them according to certain criteria. Systematic review is a research activity in which data are obtained from primary study data rather than direct applications (Needleman, 2002). In this study, the internationally recognised PRISMA checklist was used for reporting systematic review studies. The process of this study is shown in Figure 3 within the framework of the PRISMA checklist:

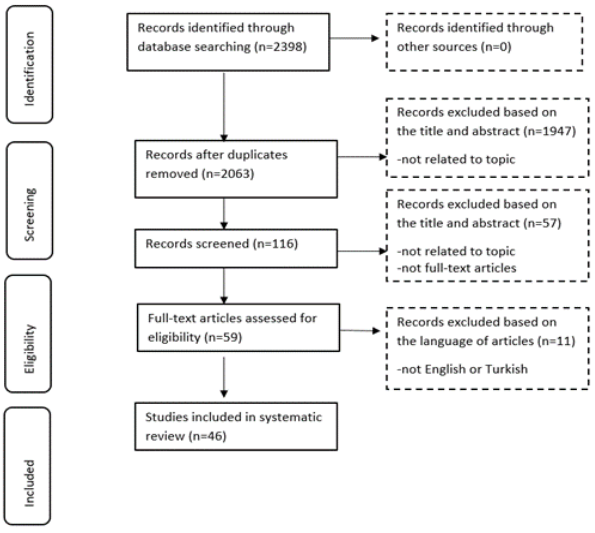

Figure 3.
PRISMA checklist for reporting systematic review studies

In the study, firstly, studies containing keywords in their abstracts and titles were determined as a result of the search conducted in the determined databases (n=2398). In the second stage, the same studies reached in different databases were eliminated (n=2063). The next stage was the elimination of studies containing relevant keywords in their abstracts and titles but not related to the research topic (n=1947). After eliminating the remaining studies (n=116), the studies whose full texts could not be reached (n=57) and those not published in English or Turkish (n=11), 46 studies were included in the study.

A total of 46 studies related to WebQuest in mathematics education from its creation in 1995 to the present day (01.11.2023), were reached by using the keywords "WebQuests and mathematics" and its Turkish translation “WebQuest ve matematik”, "Ag arastırması ve matematik", “ag sorgulaması ve matematik”, “ağ araştırması ve matematik”, "web macerası ve matematik" in the databases such as Council of Higher Education (CoHE) national thesis search centre, proquest, google scholar, science direct, national academic (ULAKBIM), scopus, web of sicence, Educational Resources Information Centre (ERIC), Education Full Text (H. W. Wilson), Taylor & Francis, Australian Education index, British Education index, EBSCO Academic Search Premier and Educational Research Complete. In the review of the scientific studies reached in the scans, the conditions of being in the field of mathematics education, being published in full text, being open to access, and being published in English or Turkish language were sought. The reviewed studies are given in the appendix.

The studies were firstly categorized according to Abbitt and Ophus' (2008) primary classification system as Research, Descriptive, or Information. At the secondary level, the year of publication, type, source of publication, keywords used in the study, research topic, learning domain and mathematics subject to which the WebQuest is related, research model, sample type, sample size, sampling method, data collection tools, data analysis methods/techniques and the results of the studies related to WebQuest in mathematics education were examined by thematic analysis. Due to the heterogeneous nature of the articles included in the current review (i.e., quantitative experimental studies, qualitative studies, literature reviews, and case studies), it was not possible to conduct a meta-analysis or further quantitative comparison. Therefore, the results were analysed using thematic analysis. To ensure validity and reliability in determining themes and reduce researcher bias, we followed the Collaborative Constant Comparative Qualitative Analysis

Process (Richards & Hemphill, 2018) guideline. Consensus coding was performed through the constant comparative method (Strauss & Corbin, 2015) in weekly meetings, and disagreements were discussed until the coders reached consensus.

The ethical process in the study was as follows:

- Ethics committee approval was obtained from Balıkesir University Science and Engineering Sciences Ethics Committee (Date: 28.02.2023, Number: E-19928322-108.01-235510)

Results

In this part, the results of 46 included studies on WebQuest in mathematics education were presented.

Analysing the Studies in Terms of Demographic Information

The distribution of studies analysed within scope of this study by years is shown in Table 2 and the change by years is shown in Figure 4.

Table 2.

Distribution of studies by years

Year	Code	f	Year	Code	f
2001	A24	1	2014	A11,A19,A25	3
2002	A21,A39	2	2015	A18	1
2005	A1,A37	2	2016	A23,A38,A40,A42	4
2007	A2,A9,A22,A35	4	2017	A8,A14,A43	3
2008	A15,A28	2	2018	A10, A41	2
2009	A29,A32,A36	3	2019	A33	1
2010	A12,A20	2	2020	A17	1
2011	A4,A5,A16	3	2021	A26,A31,A44	3
2012	A13,A27,A30	3	2022	A46	1
2013	A6	1	2023	A3,A7,A34,A45	4

Upon examining Table 2, the frequencies of 46 studies published in various sources vary according to years. Although WebQuest was introduced in 1995, the first study on WebQuest in mathematics education (A24) was conducted in 2001. While no study was found in 2003, 2004, 2006, the years in which the studies in the sources increased were 2007 (A2,A9,A22,A35), 2016 (A23,A38,A40,A42), 2023 (A3,A7,A34,A45). There are f=4 studies in these years. Although there are studies with variable frequency in terms of mathematics education literature, it can be said that WebQuest is still a model that attracts the attention of researchers and remains up-to-date. The changes in Table 2 are shown in Figure 4.

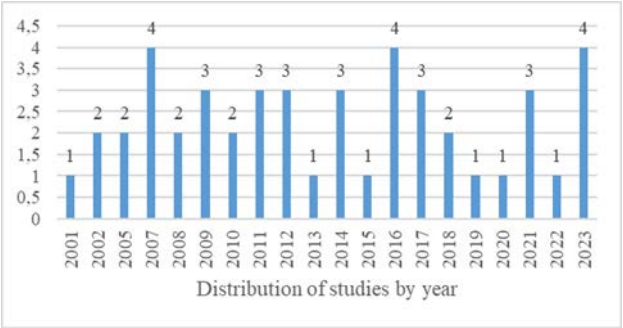

Figure 4.

The change of the studies by years

The frequencies and percentages of source languages found in the publications analysed are shown in Table 3.

Table 3.

Distribution of studies by publication language

Language	Code	f	%
Turkish	A1,A2,A3,A4,A5,A6,A7,A8,A9,A10, A11,A12,A13, A14,A20,A46	16	34.78
English	A15,A16,A17,A18,A19,A21,A22,A23 ,A24,A25,A26,A27,A28,A29,A30, A31,A32,A33,A34,A35,A36,A37,A38 ,A39,A40,A41,A42,A43,A44,A45	30	65.72
Total		46	100

It was found that 16 of the 46 studies were published in Turkish and 30 studies were published in English. The majority of the studies on webquest in mathematics education (65.72%) published in English. Since the inclusion condition for this review was articles published in Turkish and English, only these languages were analysed. Considering the foreign literature, it is expected that there are more English studies than national studies. The pie chart of the data on the distribution of studies by language in Table 3 is shown in Figure 5.

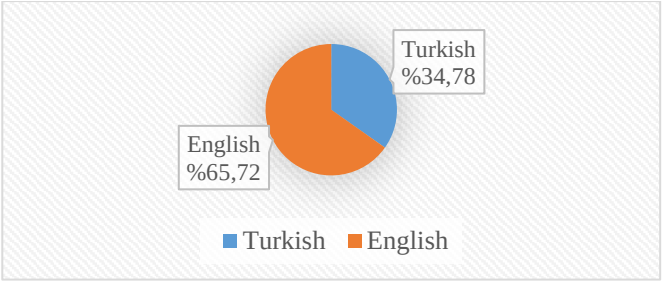

Figure 5.

Distribution of studies by language

The distribution of the studies according to the publication type are shown in Figure 6.

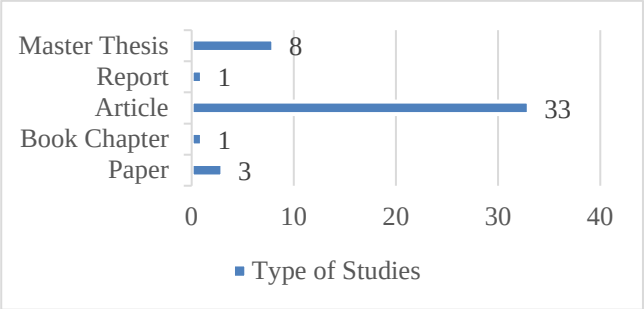

Figure 6.
Distribution of studies by type

In Figure 6, it is seen that article publication is the most common type of publication, followed by thesis and paper. Detailed analysis shows that 71.74% (f=33) were published as articles, 17.39% (f=8) as dissertations, all of which were Master's theses, 6.52% (f=3) as conference papers and 4.34% as book chapters (f=1) and reports (f=1). Table 4 shows the distribution of studies by the publication sources.

Table 4.
Distribution of studies by publication sources

Type	Publication sources	Code	f
Paper (f=3)	9th International Conference on Technology and Education: Tallahassee, Florida	A24	1
	5th World Conference on Educational Sciences - WCES İtaly	A25	1
	6th International Conference on Advanced Learning Technologies (ICALT), Austin, TX, USA	A40	1
Book Chapter (f=1)	International Research in Educational Sciences XI	A46	1
Article (f=33)	Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education	A8	1
	Elementary Education Online	A9	1
	The Journal of Balikesir University Institute of Science and Technology	A10	1
	Journal of Qualitative Research in Education	A11	1
	E-Journal of New World Sciences Academy	A12	1
	Kırşehir Education Faculty Journal (KEFAD)	A13	1
	Mustafa Kemal University Journal of Graduate School of Social Sciences	A14	1
	The Clearing House: A Journal of Educational Strategies, Issues and Ideas	A15	1
	Tojet: The Turkish Online Journal of Educational Technology	A16	1
	International Electronic Journal of Mathematics Education	A17	1
	Revista Latinoamericana De Etnomatemática	A18	1
	Computers & Education	A19	1
	Ankara University, Journal of Faculty of Educational Sciences,	A20	1
	Nade Diegest	A22	1
	Educational Research and Reviews	A23	1
	Teaching and Teacher Education	A26	1
	The New Educational Review	A27	1
	International Journal of Mathematical Education In Science and Technology	A28	1
	Turkish Online Journal of Distance Education-TOJDE	A29	1
	Teaching Mathematics and Its Applications	A30	1
	Eurasian Journal of Educational Research	A31	1
	Journal of Applied Sciences	A32	1
	International Journal of Recent Technology and Engineering (IJRTE)	A33	1
	Information Sciences Letters	A34	1
	International Journal For Technology in Mathematics Education	A35, A36	2
	Computers in the Schools	A37	1
	International Journal of Education in Mathematics, Science and Technology	A38	1
	Eric Document EA1174086	A39	1
	European Journal of Education Studies	A41	1

Report (f=1)	World Journal on Educational Technology	A42	1
	Universal Journal of Educational Research	A43	1
	Bulletin of Science and Practice	A44	1
	Chancellor's Honors Program Projects	A21	1
Thesis (f=8)	Balıkesir University Institute of Science	A1, A6, A7	3
	Eskişehir Osmangazi University, Institute of Social Sciences	A2	1
	Ordu University, Institute of Social Sciences	A3	1
	Suleyman Demirel University Graduate School of Applied and Natural Sciences	A4	1
	Gazi University, Graduate School of Educational Sciences	A5	1
	Mansoura University Faculty of Specific Education Computer Teacher Preparation Department	A45	1

According to Table 4, mostly studies (A1, A6, A7) are seen as theses (f=3) published in the same source (Balıkesir University Institute of Science). In addition, in the article category, the studies coded A35 and A36 are seen in the same source (International Journal for Technology in Mathematics Education).

Analysing the Studies in Terms of Content

In this part, the findings related to the keywords of the studies, the research topics and the mathematics subject that the prepared WebQuests focus on are presented.

The keywords specified by the authors of the reviewed study were first recorded in a Microsoft Excel worksheet, and then a word cloud was prepared with the specified keywords (Figure 7):

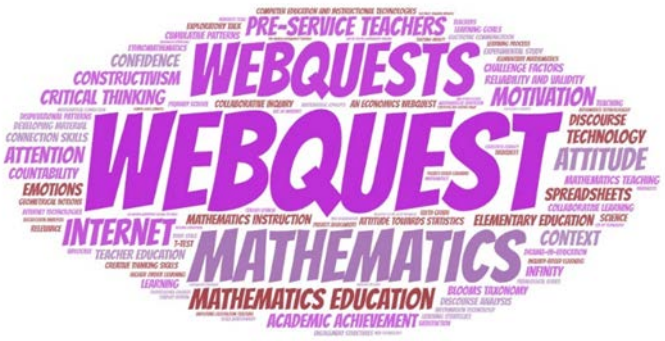

Figure 7.
Word cloud related to the keywords
Created by utilising https://wordart.com/

The word cloud highlights prominent keywords such as WebQuest, WebQuests, mathematics, mathematics education, pre-service teachers, internet, academic achievement, attitude, motivation indicating their significance in the context. Detailed analysis shows that the word "WebQuest" (f=23) and "WebQuests" (f=8) was the most used out of 161 keywords, followed by 'mathematics' (f=8) and "mathematics education" (f=7).

Table 5 shows the distribution of research topics in studies. The purposes of the studies were analysed using Abbitt and Ophus's (2008) primary classification method. According to Abbitt and Ophus's (2008) primary classification method; the studies including WebQuests such as experimental design, action research, case study, etc. were classified under the themes of research; studies in which the theoretical foundations were laid regarding the concept of WebQuest in general or the use of WebQuest in education were classified under the themes of informational and studies involving the development of a WebQuest were classified under the themes of descriptive.

Table 5.
Distribution of research topics in studies

	Research topics	Code	f
Research (f=36)	Academic success	A1, A2, A13, A19, A34, A41, A45, A43	8
	Attitude towards mathematics	A1, A2, A13, A19, A27	5
	Opinion review	A1, A6, A24, A9, A36, A38, A11, A43	8
	Critical thinking	A4, A8, A31	3
	Creative thinking	A5	1
	Motivation	A5, A16, A28, A42	4
	Learning satisfaction	A19	1
	Geometric thinking	A46	1
	Analysing mathematical discourses	A3, A37	2
	Understandings about the nature of mathematics	A18	1
	Dialogue between students	A18	1
	The ways of learning mathematics	A18	1
	Qualifications of developing WQ activities	A6, A10	2
	Levels of including connections in WQs / used Contexts in WQ activities	A6, A14	2
	Statistical literacy	A7	1
	Attitude towards statistics	A7	1
	Statistical self-efficacy belief	A7	1
	Teaching anxiety level	A32	1
	Electronic communication skills	A34	1
	Problem posing skills	A35	1
	Attention	A42	1
	Confidence	A42	1
	Relevance	A42	1
	Satisfaction	A42	1
	The higher cognitive levels of Bloom's taxonomy	A40	1
	Professional development	A26	1
	The potential to help students tolerate ambiguity associated with the dialectic interplay of collaborative inquiry	A17	1
	Scale development	A20, A23	2
Informational (f=3)	To reveal the advantages of using WQ in mathematics	A44	1
	Introducing how to use WQ in mathematics	A12	1
	To introduce the integration of WQ with bloom taxonomy and higher order thinking skills in mathematics learning environments	A39	1
Descriptive (f=7)	To introduce a sample WebQuest	A15, A21, A22, A25, A29, A30, A33	7

In terms of study purpose classification, the majority of the studies (f=36) are research studies. An analysis of Figure 7 shows that 8 of the 55 research studies focus on opinion review, while a further 8 studies focus on academic achievement. Additionally, 5 studies were conducted on attitude towards mathematics, and 4 studies were conducted on motivation. Among the 7 studies categorised as descriptive, aim to intoduce a sample WebQuest (Fig. 8).

Figure 8.

The distribution of research topics in the studies

Figure 9 displays the distribution of the learning area prepared WebQuests focus on, as found in the analysed studies.

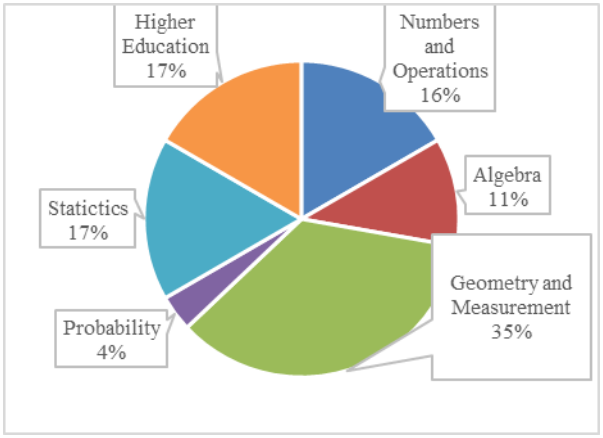

Figure 9.

Distribution of the learning area prepared WebQuests focus on

Upon examining the learning areas covered by webquests in mathematics education (Fig. 9), it is evident that the majority of WebQuests are related to the learning area of geometry and measurement (35%). In contrast, the area of probability is the least focused upon when compared to other learning areas (4%). Details regarding the frequency distributions according to the subjects related to each learning area are given in Table 6.

Table 6.
Distribution of mathematics subject prepared WebQuests focus on

LA	f	Subject	Code	f
Numbers and Operations	9	Decimal notation	A1, A17	2
		Division Operation	A2	1
		Percentages	A17, A21	2
		Ratio and Proportion	A18, A19	2
		Pattern	A18	1
		Decimal Base System	A37	1
Algebra	6	Introduction to Algebra	A40	1
		Solution of Linear Equations	A17	1
		Average Speed	A17	1
		Coordinate system	A25	1
		Cryptography associated with matrices	A21	1
		Setting up equations	A21	1
Geometry and Measurement	19	Plane and Volume Measurement	A2	1
		Geometric objects and shapes	A3, A12, A20, A29, A40	5
		Surface area and volume in prisms	A4, A8	2
		Area and volume relations of cylinder	A5, A13	2
		Volume of Cube	A17	1
		Perimeter of a rectangle	A17	1
		Perimeter of the square	A17	1
		Angles in a triangle	A17	1
		Area of Composite Shapes	A17	1
		Area of the Circle	A17	1
		Mass Unit	A17	1
		Symmetry	A18	1
		Area of Circle Slice	A46	1
Probability	2	Probability of Simple Events	A17	1
		Probability	A43	1
Statistics	9	Arithmetic Mean	A2, A27	2
		Line graph	A2, A27	2
		Histogram	A11	1
		Column chart	A20	1
		Data analysis	A43	1
		Drawing data set graphs	A21	1
		Basic statistical calculations	A21	1
Higher Education	9	Conics	A30	1
		Derivative	A33	1
		Infinity and Countability	A41	1
		Topology	A34, A38	2
		Geometry concept	A34	1
		Number concept	A34	1
		Basic maths skills	A45	1
		Descriptive and Inferential statistics	A7	1

As seen Table 6, it becomes apparent that 5 studies (A3, A12, A20, A29, A40) addressed "geometric objects and shapes" (f=5) in the "geometry and measurement" learning area (f=19). In some of the analysed studies, WebQuest was prepared by the participants (A6, A9, A10, A14, A16, A24, A28, A31, A32, A35, A36, A42). The topics covered in these studies were as follows: Introduction of three-dimensions, volume in three-dimensions, two-dimensions, perimeter and area calculations, numbers, fractions, length units in the field of geometry in the study coded A9; numbers and

operations and numbers, operations, fractions, three-dimensional shapes, volume, quadrilaterals, triangles, area, perimeter in the field of geometry in the studies coded A16 and A28; triangles or quadrilaterals in the field of geometry in the study coded A24; triangles or quadrilaterals in the field of geometry in the study coded A31; middle school 5-8. In the study coded A35, Pythagoras and Euclidean Theorems, Fractal Geometry, The Role of Graphing Calculator in Solving Equations, Mental Mathematics Basic Education, Mathematicians in Arab civilisations and Mathematics and unknown sports; in the study coded A36, triangles, circles, rectangles, area, perimeter, etc. in the field of geometry; in the study coded A42, functions, sets, logarithms, 3-dimensional figures, ratios and proportions, triangles, verbal problems, factorisation. In addition, the participants prepared WebQuests activites by choosing different levels in the mathematics curriculum for example 6-8. Grades level (A6), 5-8 grades level (A12), any mathematics subject (A10).

Analysis of The Studies in Terms of Methodology

This section presents the findings obtained from the data analysis regarding the methodological tendencies of the analysed studies. Figure 10 shows the distribution according to the research methods adopted in the studies.

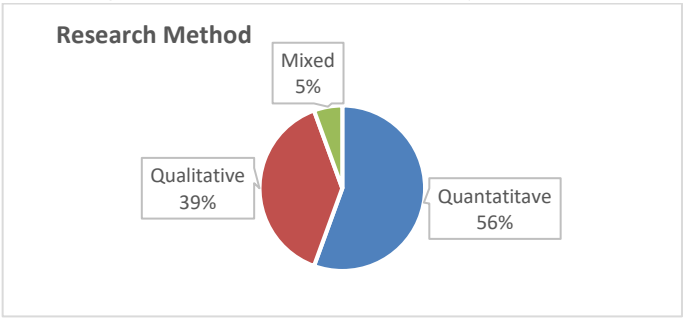

Figure 10.

Distribution according to the research methods adopted in the studies

Figure 10 shows the distribution of research methods: 56% quantitative, 39% qualitative, and 5% mixed methods. Additional details can be found in Table 7.

Table 7.

Distribution of the studies according to research methods and designs

RM	Code	f	RD	f	%
Quantitative	A2,A4,A5,A8,A10, A13,A16,A18,A19, A20,A23,A27,A28, A32,A34,A35,A40, A42,A43,A45	20	Experimental design	14	36.84
			Descriptive research	3	7.89
			Scale development	2	5.26
			Teaching experiment	1	2.63
			Correlational research	1	2.63
			Unspecified	1	2.63
Qualitative	A3,A6,A9,A11,A14, A17,A24,A26,A31, A36,A37,A38,A41, A46	14	Document Analysis	4	10.53
			Case study	3	7.89
			Phenomenology	2	5.26
			Action Research	1	2.63
			Unspecified	4	10.53
Mixed	A1,A7	2	Variation	1	2.63
			Parallel Convergent Pattern	1	2.63
Informational/ Descriptive studies		10			
Total		46			

Upon analysing Table 7, it is evident that 36.84% of the 20 quantitative studies were conducted using an experimental design (f=14), 7.89% using a descriptive design (f=3), and 5.26% using scale development (f=2). In qualitative studies, 10.53% of the studies were document analysis (f=4), 7.89% were case studies (f=3), and 5.26% were phenomenology (f=2). Mixed designs were explained as variation (f=1) and parallel convergent design (f=1) with a rate of 2.63%.

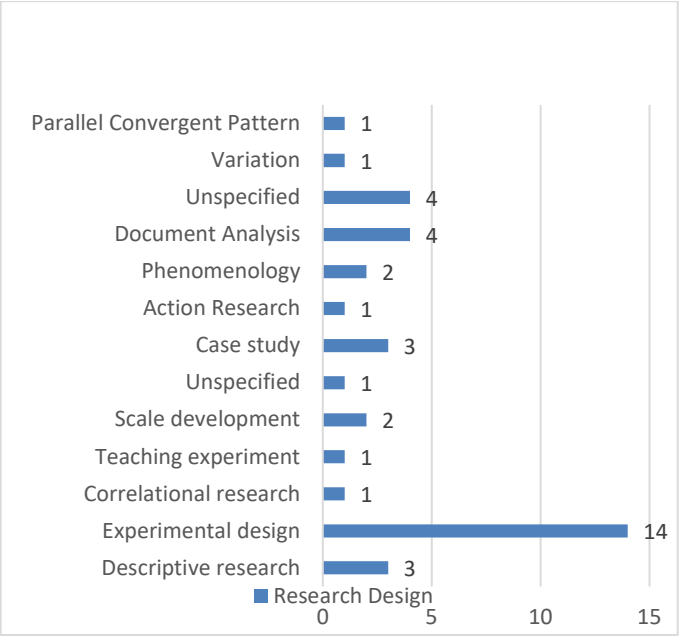

Figure 11.
Distribution according to the research design adopted in the studies

Results related to the sample group determined in the studies are shown in Figure 12.

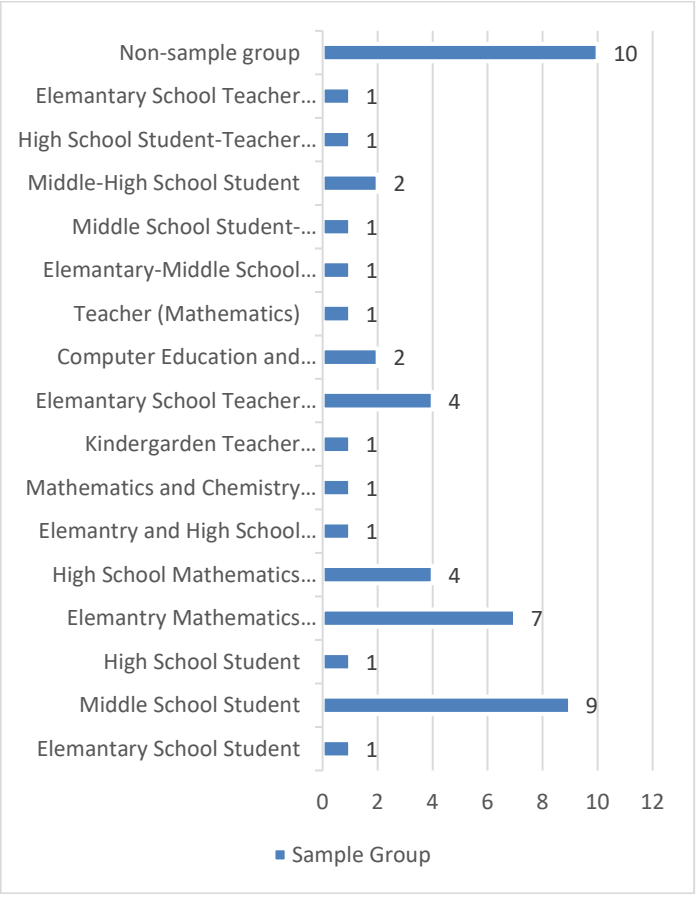

Figure 12.
Distribution according to the sample group in the studies

There is no sample group in 10 studies (informational/descriptive). The majority of the 36 research studies was conducted with middle school students (f=9). As can be seen in Figure 12, there are a significant number of studies that include pre-service elementary mathematics teachers (f=7) in the sample group. Considering that pre-service elementary mathematics teachers will also teach in middle school in grades 5-8, it can be said that middle school mathematics is given importance in the studies on WebQuest in mathematics education.

The codes, frequencies and percentages of these studies are presented in Table 8.

Table 8.
Distribution of the studies according to the sample group

Sample Group		Code	f	%
Elemantary School Student		A3	1	2.17
Middle School Student		A1,A2,A4,A5,A8,A13, A19, A27,A46	9	19.57
High School Student		A18	1	2.17
Teacher Candidate (TC)	Elemantry Mathematics TC	A6, A31, A14, A24, A35, A38, A41	7	15.22
	High School Mathematics TC	A7, A10	2	4.35
	Elemantry and High School Mathematics TC	A36	1	2.17
	Mathematics and Chemistry TC	A42	1	2.17
	Kindergarden TC	A34	1	2.17
	Elemantary School TC	A9, A16, A28, A32	4	8.70
	Computer Education and Instructional Technologies TC	A23, A45	2	4.35
Teacher (Mathematics)		A11	1	2.17
Elemantary-Middle School Student		A40	1	2.17
Middle School Student-Teacher (Mathematics and Science)		A26	1	2.17

Middle-High School Student	A17, A37	2	4.35
High School Student-Teacher (Mathematics)	A43	1	2.17
Elemantary School Teacher Candidate and Teacher (Elemantary School)	A20	1	2.17
Non-sample group	A12, A15, A21, A22, A25, A29, A30, A33, A39, A44	10	21.74

The distribution of studies on WebQuest according to the type of sample group shows that there are f=14 studies with students (elemantary school, middle school, high school, elemantary school-middle school, middle school-high school), f=19 studies with teacher candidates, and f=4 studies with teachers. Based on the analysed studies, it is seen that researchers studying in mathematics education mostly prefer to conduct the study on teacher candidates, and this finding is followed by the studies conducted with students. As a matter of fact, it can be said that the effects of WebQuest activities are mostly investigated at the middle school level among students.

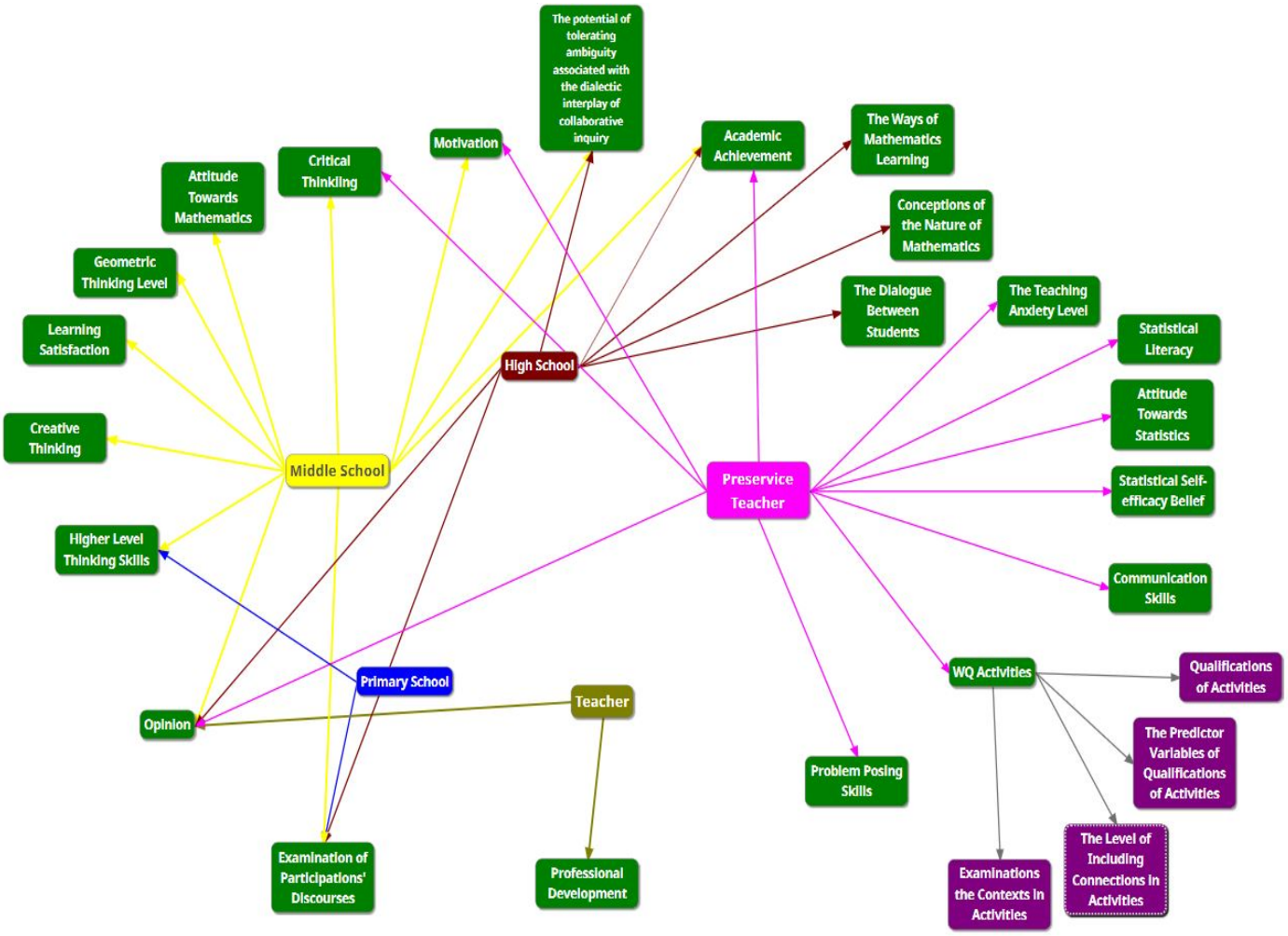

Figure 13.
Distribution of research topics in the studies based on sample groups Created by utilising https://www.mindmup.com/

Figure 13 shows a network of themes explored in the sample groups. The most common research topics of the studies on WebQuest in mathematics education are academic achievement (f=8), opinion review (f=8), attitude towards mathematics (f=5) and motivation (f=4) (Table 5). The findings on the sample groups on which these topics were investigated show that the effect of WebQuest on the academic achievement of middle school, high school and teacher candidates has been examined, but no study has been conducted with elemantary school students on this subject. The studies in which attitude towards mathematics was investigated were carried out only with middle school students. While the studies on the effect of WebQuests on motivation, which is an important part of learning, were conducted with middle school students, the studies in which participant views were examined were conducted with all sample groups except elemantary school students.

When analysing the sample group separately, studies have been conducted on the development of higher-order thinking skills and the examination of discourses among elemantary school students. However, the effects of

WebQuest on academic achievement, attitude, motivation, critical and creative thinking, ways of learning mathematics, problem-posing skills, and learning satisfaction in mathematics courses are yet to be investigated on the elemantary school students. Although many topics in high school mathematics courses have been studied, the impact of WebQuest on the problem-solving skills has not been investigated. Previous studies with high school groups have consulted student opinions about WebQuest applications and examined student discourses and dialogues during the applications. Furthermore, research has also explored the impact of WebQuest on academic achievement, mathematics learning styles, and perceptions of the nature of mathematics among high school students. Investigating the effects of WebQuest on motivation, higher-order thinking skills, problem-posing abilities, as well as creative and critical thinking in this age group would make a valuable contribution to the field.

One of the sample groups studied were teacher candidates. The research topics covered critical thinking, motivation, academic achievement, problem posing skills, statistical literacy, attitude towards statistics, and statistical self-efficacy belief. Although there have been studies on the impact of WebQuest on teacher candidates' anxiety levels, researching on teachers related to this topic would make a valuable contribution to the field of mathematics education literature. One crucial aspect of the studies conducted with teacher candidte is their preparation of WebQuest activities and obtaining feedback on them. These studies aimed to examine the applicability of WebQuest in mathematics lessons, the contributions and limitations of preparing WebQuest activities, as well as the qualifications of the WebQuest activities they prepared and the mathematical associations and contexts of these activities. The studies conducted with teachers also examined the effect of WebQuest on teachers' professional development, in addition to obtaining opinions on the applicability of WebQuest.

Figure 14 displays the distribution of studies based on sample sizes. There are 16 studies with sample sizes between 36-70, 9 studies with sample sizes between 0-35, 6 studies with sample sizes of 101 and above, and 4 studies with sample sizes between 71-100.

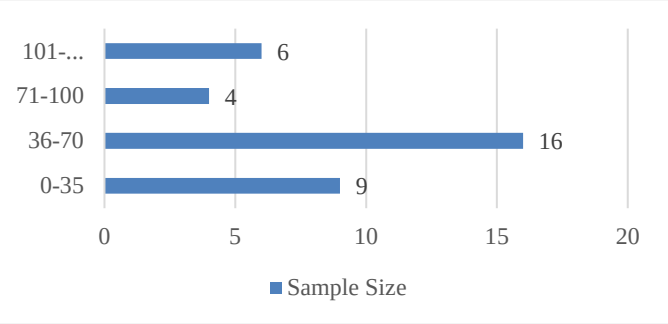

Figure 14.
Distribution of the studies according to the sample sizes

Upon examining the findings related to the sample sizes in Figure 14, it is observed that 11 of these studies did not mention the sample size. In 10 of these studies, document analysis is performed, and informational content related to the introduction of a webquest is discussed. However, 1 study did not indicate the size of the sample group. Table 9 discusses the sampling methods and characteristics in the studies.

Table 9.
Distribution of the studies according to the sampling methods

SM	Code	f		f
Random Sampling	A1,A2,A5,A13,A34, A41,A43	7	Simple Random Sampling	6
Non-random Sampling	A3,A6,A7,A14,A16, A19,A23,A26,A28, A32,A38,A41,A42, A46	14	Purposive Sampling	7
			Convenience Sampling	7
The whole population included in	A4,A8	2		

the sample group		
Unspecified	A18,A35,A36,A37, A27,A31,A20,A24, A40,A45,A17,A9,A10, A11	14

The 36 studies, excluding the 10 informational/descriptive studies that did not have a sample group, were analysed in terms of the methods used in the selection of the sample. The findings in Table 9 show that the samples in the studies were mostly determined by non-random sampling method (f=14). It is seen that 7 of the studies conducted with non-random sampling were determined by purposive sampling and 7 were determined by convenience sampling. In addition, Table 9 shows that there were 2 studies (A4, A8) in which the entire population was included in the sample, and 14 studies (A18, A35, A36, A37, A27, A31, A24, A20, A40, A45, A17, A9, A11, A10) in which the sampling method was unspecified. In addition, pie charts related to the sampling method are presented in Figure 15.

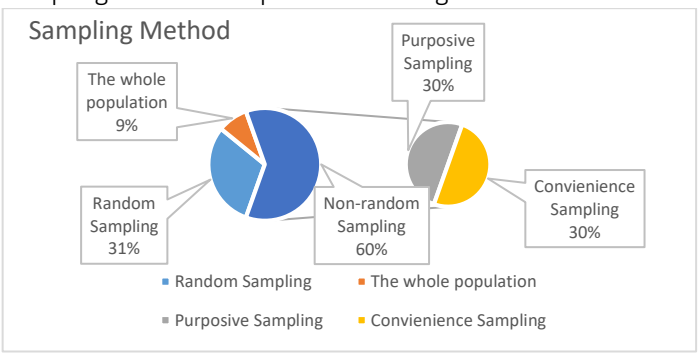

Figure 15.
The distribuiton of studies according to sampling method

Figure 15 shows that non-random sampling method was preferred in 64% of the studies that mentioned sampling characteristics and methods. Purposive sampling and convenience sampling each represented 30% of these studies. In contrast, 31% of the sample was determined by random sampling. Additionally, 9% of the studies included the whole population in the sample.

Table 10 displays the data collection tools and techniques used in the methodology of the studies.

Table 10.
Distribution of the studies according to the data collection tools/techniques

Data Collection Tools/ Techniques	Code	f	%
Achievement test	A1,A2,A5,A10,A13,A20, A34, A35,A41,A45	10	17.54
Attitude/perception /interest etc. scales	A1,A2,A4,A5,A7,A20, A27,A28, A32,A8,A10,A13,A16, A42,A35	15	26.32
Interview	A1,A5,A6,A7,A9,A11, A14,A17,A18,A24,A36, A38,A41,A46	14	24.56
Observation	A6,A14,A18,A34,A46	5	8.77
Personal information form/survey	A2,A6,A5,A20	4	7.02
Researcher/student notes/reflection reports	A3,A31,A18	3	5.26
Document review	A14	1	1.75
Student products	A6	1	1.75
Voice recorder	A3	1	1.75
Video	A18	1	1.75
KWL charts	A37	1	1.75
Rubric	A40	1	1.75

According to Table 10, it was discovered that 26.32% of the studies employed scales related to affective characteristics, such as attitude, perception, and interest (A1, A2, A4, A5, A7, A20, A27, A28, A32, A8, A10, A13, A16, A42, A35). Interviews were used as data collection tools in 24.56% of the studies (A1, A5, A6, A7, A9, A11, A14, A17, A18, A24, A36, A38, A41, A46), while 17.54% of the studies used achievement tests (A1, A2, A5, A10, A13, A20, A34, A35, A41, A45). Other studies collected data through observation (8.77%), personal information forms/survey (7.02%), and researcher/student notes/reflection reports (5.26%). Figure 16 shows the frequency distribution of the data collection tools and techniques used in the studies.

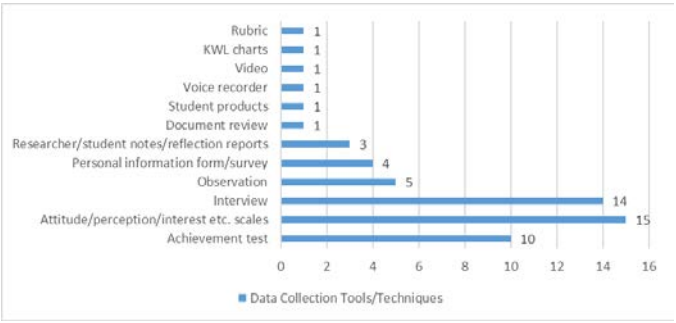

Figure 16.
Distribution of the data collection tools/techniques used in the studies

As seen in Table 10, the majority of the data collected in the analysed studies are quantitative data. The findings

obtained regarding the methods used in the analysis of this data are presented in the pie chart in Figure 17.

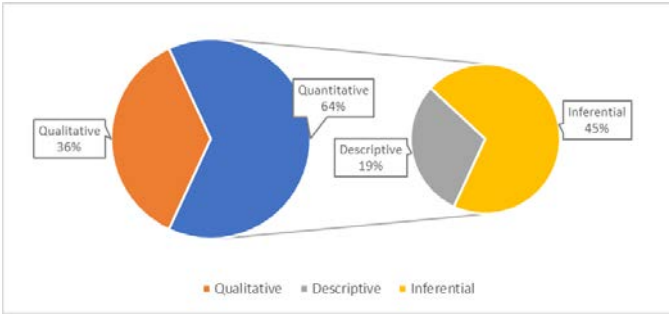

Figure 17.
Distribution of data analysis methods used in the studies

It is seen that 64 of the studies on WebQuest in the field of mathematics education preferred quantitative data analysis methods, 45% of which were inferential and 19% analysed the data with descriptive statistics (Figure 17). The preference rate of qualitative data analysis methods is 36%. Therefore, it can be concluded that quantitative studies are more commonly used. Detailed findings regarding the methods and techniques used in data analysis are presented in Table 11.

Table 11.
Distribution of the data analysis techniques used in the studies

DAM		Code	f	DAT	f	%
Quantitative (f=30)	Descriptive	A4,A5,A6,A7, A8,A9,A13, A19,A43	9	Frequency/ percentage	5	8.77
				Mean/standard deviation	7	12.28
	Inferential	A1,A2,A4,A5, A7,A27,A28, A32,A34,A35 A40,A42,A43 A45,A16,A8, A10,A13,A19 A20,A23	21	T testi	11	19.30
				Anova/Ancova	9	15.79
				Manova/Mancova	2	3.51
				Wilcoxon signed-rank test	1	1.75
				Effect Size	1	1.75
				Regression Analysis	1	1.75
				Reliability coefficient	2	3.51
				Item discrimination index	1	1.75
				Factor analysis	2	3.51
Qualitative (f=17)	Qualitative	A1,A3,A6,A7, A9,A11,A14, A31A41,A43, A46,A26,A17 A24,A36,A38 A37	17	Descriptive Analysis	3	5.26
				Content Analysis	7	12.28
				Discourse analysis	1	1.75
				Thematic analysis	1	1.75
				Continuous Comparative Analysis	2	3.51
				Existential-phenomenological data analysis	1	1.75
Informational/ Descriptive Studies			10			
Total			57			

The findings in Table 11 show that inferential analysis (f=21), one of the quantitative research methods, was mostly preferred in the studies. Additionally, it is observed that 11 studies using inferential statistics from quantitative analysis methods preferred t-test, while 9 studies preferred anova/ancova methods. Detalied analysis shows that t-test (f=11) and anova/ancova (f=9) were mostly used in the studies. If these techniques are considered as group scores used to make a comparison, it can be said that the studies are used to compare the situation between groups. Here, considering the group or groups and time or times in which the technique was used, it is thought that there are 27 studies in which it is desired to reach results such as "Webquest's ... effect/webquest's difference from ...- in terms of ...". Additionally, we found 7 studies that used descriptive statistics to report mean/standard deviation and 5 studies that used it to report percentage/frequency. Detailed analysis of the studies that preferred qualitative analysis methods shows that they mostly preferred content analysis (f=7), 3 studies used descriptive analysis and 2 studies analysed the data with constant comparative analysis. The graph regarding the distribution of data analysis techniques of the studies accompanying these frequency values is shown in Figure 18.

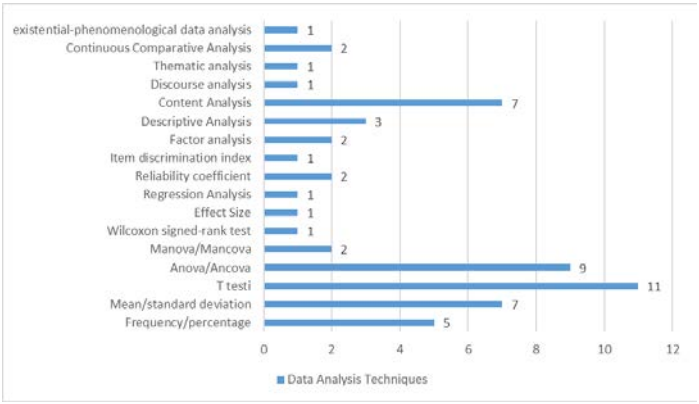

Figure 18.

Distribution of data analysis techniques used in the studies

Analysis of The Studies in Terms of Results

The findings obtained from the analysis of the results obtained from the studies on WebQuest in the field of mathematics education were interpreted under two themes: the benefits and limitations of WebQuest in the field of mathematics education:

Benefits of WebQuest in Mathematics Education

-WebQuest increases students' success in maths lessons (A1, A2, A19, A34)

-Since WebQuest supported mathematics learning environments give students the opportunity to construct knowledge, the retention of learning increases (A6, A43).

-In WebQuest supported classes, students' attitudes towards mathematics lessons are positively affected (A2, A5, A13, A27, A28). In addition, the use of WebQuest increases students' attitudes and self-efficacy beliefs in terms of statistics (A7).

-The use of WebQuests in mathematics learning environments positively affects students' motivation (A11, A16, A33) and self-confidence (A11).

-In mathematics classes using WebQuest; student discourses (A3), especially exploratory discourses increase (A37) while students use language for learning purposes, their knowledge of mathematical concepts is revealed, and students' learning becomes observable with the discourses that emerge as their mathematical communication skills improve (A3).

-WebQuest improves students' statistical literacy skills (A7).

-WebQuest supported activities positively affect students' beliefs about problem posing (A35).

-WebQuests are fun in terms of mathematics lesson (A1, A7, A9); it encourages students to think (A1, A9) and research and saves the lesson from monotony (A9). The entertaining structure of WebQuests enables students to actively participate in the lesson (A6).

-It increases visuality in mathematics lessons (A1). The visual elements in the WebQuest benefit the teacher in terms of attracting students' attention and increasing their motivation (A6).

-WebQuest increases students' electronic communication skills (A34)

-WebQuests are useful in terms of using technology and the Internet appropriately and efficiently in mathematics lessons (A6, A7, A24). Not only using but also designing WebQuests contributes positively to individuals' skills of searching the internet, preparing websites and using office programmes (A6).

-With WebQuests, students produce creative and high quality products, develop higher level thinking skills and social skills (A12).

-The use of WebQuests improves students' creativity and research skills (A33).

WebQuest supports student-centred learning environments (A17) and collaboration in mathematics lessons (A17, A24).

- WebQuests create a productive learning environment in a mathematics classroom where ethnomathematical research and drama techniques are used together, leading to greater student engagement and a higher level of cognitive engagement, benefiting students' understanding of both the nature of mathematics and mathematics as a discipline (A18).

- They provide authentic contexts for questioning real life problems (A26).

- While the use of WebQuest in mathematics courses reduces pre-service teachers' anxiety levels towards teaching (A32), it positively affects their attitudes towards learning and teaching (A36).

- In learning environments, WebQuests enable teachers to use time effectively by enabling them to reach more than one student at the same time (A6).

-WebQuests increase the high level of basic and applied mathematical knowledge of the users, which is necessary for future professional activities (A33)

-WebQuests can be used not only as a teaching technique but also as a measurement and evaluation tool in mathematics lessons (A9). Short-term WebQuests can be used as performance tasks and long-term WebQuests can be used as projects (A11). As an assessment tool, WebQuests offer reliable, highly valid and objective assessment (A6).

-The process of designing WebQuest activities increases the contextual knowledge and association skills of the preparer (A14).

-WebQuest design increases the mathematical knowledge level of the preparer and positively affects teaching competences in terms of mathematical associations, permanent learning and problem posing (A6).

The benefits of WebQuests in mathematics education are summarised in Figure 19.

Limitations of WebQuest in Mathematics Education

-Preparation of WebQuests is difficult and challenging (A9). It is time consuming for the preparers (A6, A9, A24)

-It is difficult to find reliable internet resources to prepare WebQuests (A6, A24). The fact that internet resources are not related to the subject and are not appropriate for the level of the students is one of the important limitations encountered (A6).

-The limited number of WebQuests that can be used in learning environments and the fact that the existing ones are not appropriate for student level make it difficult to use (A6).

-The adequacy of a WebQuest is related to the level of use of information and communication technologies by those who prepare it and those who will use it (A6, A10). It is difficult to use when the technology usage skills of teachers and students are not sufficient (A6). As a matter of fact, students had difficulties in WebQuest supported learning environments due to their ability to research on the internet and use technology (A1, A7).

-In WebQuest learning environments, it is difficult to apply if the prerequisite knowledge of individuals is not sufficient (A6).

The limitations of WebQuests in mathematics education are summarised in Figure 20.

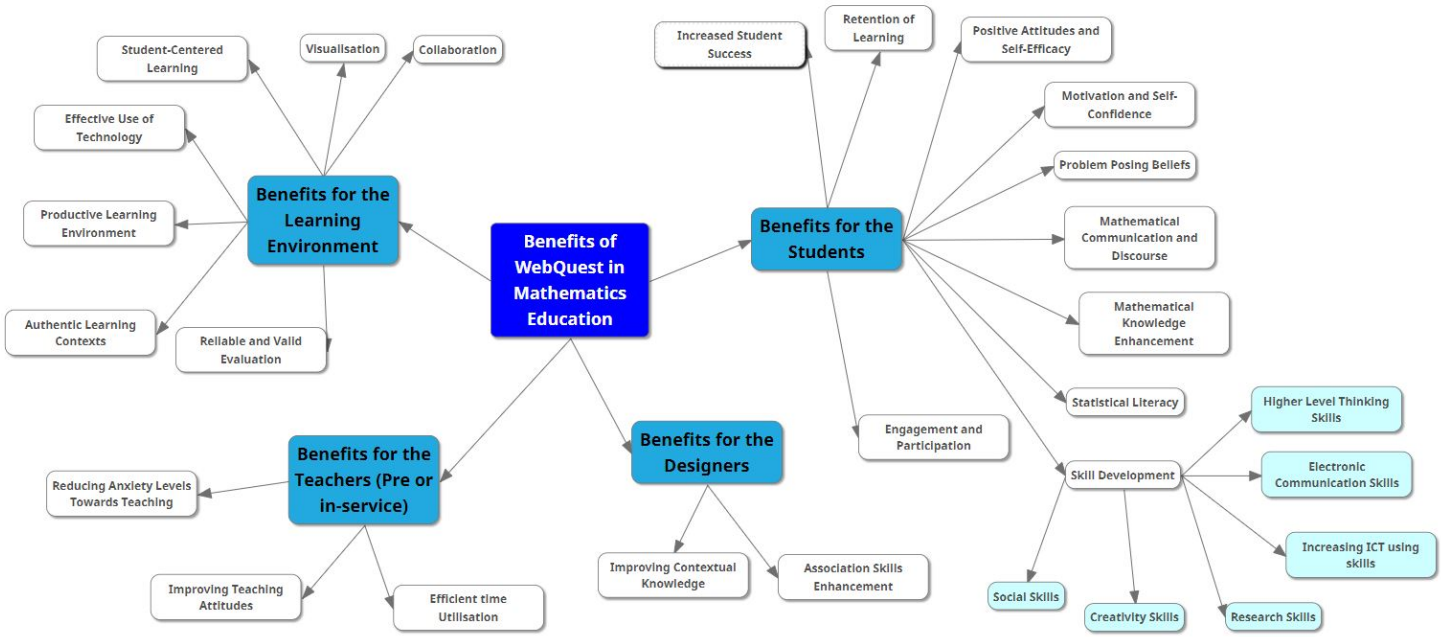

Figure 19.

Benefits of WebQuests in mathematics education Created by utilising https://www.mindmup.com/

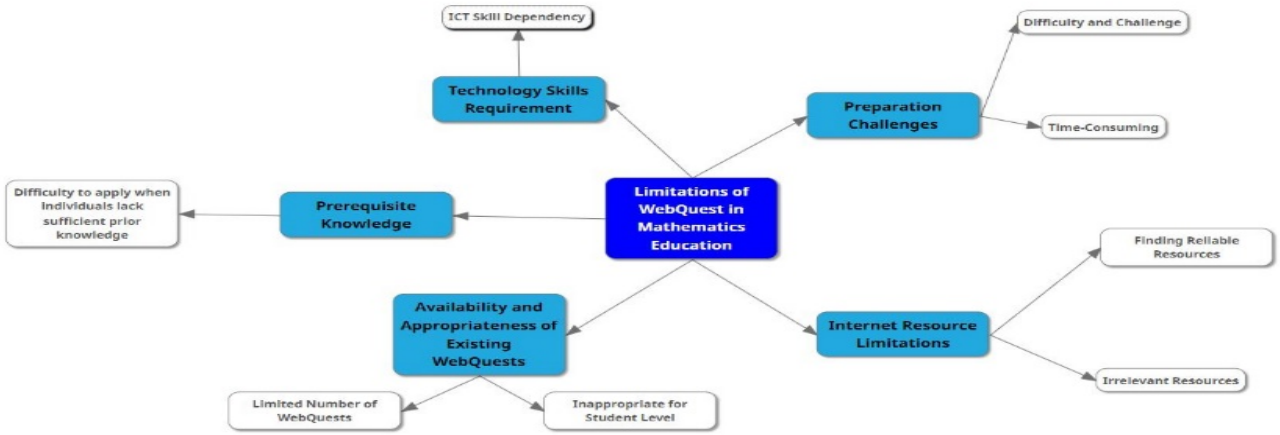

Figure 20.

Limitations of WebQuests in mathematics education Created by utilising https://www.mindmup.com/

Discussion

This study aims to contribute to the literature by compiling studies on WebQuest in mathematics education between 1995 and 2023 and to identify trends of the WebQuest instructional strategy in the field of mathematics education related to WebQuest.

The results of our study show that although WebQuest emerged in the 1990s, the first study in mathematics education was conducted in 2001. While WebQuest studies have appeared in the literature with varying frequency over the last 30 years, the fact that almost half of the 46 studies (f=24) were conducted in the last decade shows its popularity in mathematics education research. An analysis of the distribution of studies by language shows that the majority (65,72%) were written in English. The distribution of studies by type showed that most of the studies on WebQuest in mathematics education were articles (71.74%) and a small number of theses (17.39%). Bilir (2023) analysed the studies on WebQuest conducted in Turkey between 2007 and 2022 and concluded that the majority of the studies were master's theses (45.7%). The most important reason for this situation may be that Bilir (2023) concentrates only on the studies conducted in Turkey and determines the general tendencies towards WebQuest rather than a specific field.

It can be seen that the most recurrent keyword in the studies analysed in terms of content is "WebQuest". In addition, "WebQuests", "mathematics" and "mathematics education" are frequently used keywords in the studies. This is an expected result in line with the focus of the study. The primary classification of studies according to Abbitt and Ophus (2008) shows that 36 out of 46 studies are research studies. Abbitt and Ophus (2008) concluded that the majority of studies on WebQuest (f=53) were descriptive studies. In the secondary classification of the analysis, the research topics were analysed and it was found that the studies mostly aimed to examine the effect of WebQuest on academic achievement (f=8) and to examine the views of the participants on WebQuest (f=8). The number of studies presenting sample WebQuests for the use of WebQuests in mathematics education is considerable (f=7). The analyses made on the basis of learning areas show that the WebQuests are located in the learning area "geometry and measurement" (35%) and the topic is related to "geometric objects and shapes" (f=5) compared to other learning areas. Bilir (2023) study shows that in the studies related to WebQuest conducted in Turkey, WebQuest related to prisms and measurement (10.7%) was prepared the most in the field of mathematics.

The results obtained regarding the methodological tendencies of the studies show that the majority of the studies (56%) were designed with a quantitative approach, and the experimental design (36.84%) was adopted in terms of research design. Similarly, Bilir's (2023) study shows that a quantitative approach is adopted in the majority of the studies on WebQuest (50%) and experimental design (43%) is adopted from quantitative research methods. Khairunnisa (2021), who examined the studies on Webquest in the field of ELT with a systematic literature review, also shows that the majority of the studies conducted are quantitative (60.7%) and experimental design (67.8%). The frequently used methods/techniques used to collect data in the studies examined in this study are Attitude/perception/interest etc. Scales (f=15), interview (f=14) and achievement test (f=10). It can be said that the collected research data are mostly analysed by using quantitative analysis method (64%), while this is mostly inferential statistics (45%). T test is a statistical technique frequently used in research (f=11). Bilir (2023) also concluded that the most frequently used statistical technique to collect data is scale (40,7%) and t-test is preferred to analyse the data (27%). Similarly, it is seen that pre-post test (60.7%) is frequently used in studies on WebQuest in the field of ELT (Khairunnisa, 2021). Alias et al. (2013), who analysed 13 studies on WebQuest conducted between 2005 and 2012, concluded that quasi-experiment research design (60%) was mostly used in the studies.

The distribution of the studies according to the sample groups shows that the majority of the studies were carried out with pre-service teachers (f=19), and in terms of K-12 level students, most secondary school students (f=9) participated in the studies. This result supports the result of Bilir (2023) that the majority of the studies on WebQuest conducted between 2007 and 2022 were conducted with secondary school students. Khairunnisa (2021) concluded that studies on WebQuest in the field of ELT were mostly conducted on students (39.3%) regardless of the level of education. It is among the results that the majority of the sample groups in the studies consisted of 36-70 people, and the sampling technique preferred in the selection of these participants was purposive and appropriate sampling (64%), one of the non-random sampling methods. Bilir (2023) shows that the majority of the studies on WebQuest were conducted with a sample size of 0-80. As a matter of fact, when the participants of this study between 0-70 people are analysed, the fact that more than half of the 46 studies (f=25) are in this range coincides with the results of Bilir (2023).

In current research, the studies on WebQuest in the field of mathematics education have been evaluated based on sample groups and research topics. The results indicate the following:

Academic Achievement:

The impact of WebQuest on academic achievement has been examined among middle school, high school, and pre-service teachers, while no studies have been conducted with elementary school students in this regard.

Attitudes and Motivation:

The studies on the effect of WebQuest on attitudes towards mathematics have been conducted exclusively with middle school students. Its impact on motivation has been researched with middle school students and pre-service teachers.

Participant Opinions:

The studies investigating participant opinions have been conducted with all sample groups except elementary school students.

The results according to the sample groups show that:

Elementary School Students:

The studies have focused on the development of higher-order thinking skills and discourse analysis through WebQuest activities among elementary school students. However, the effects on academic achievement, attitudes, motivation, and other skills have yet to be explored in this group.

High School Students:

While many topics have been studied in high school mathematics classes, the impact of WebQuest on problem-posing skills has not been examined. It is recommended that future research investigates the effects of WebQuest on motivation, higher-order thinking skills, and creative/critical thinking within this age group.

Pre-Service Teachers:

The studies involving this group have covered topics such as critical thinking, motivation, academic achievement, problem-posing skills, and statistical literacy. Although studies have examined the impact of WebQuest on pre-service teachers' anxiety levels, no such research has been conducted with in-service teachers. Additionally, studies have explored the process of pre-service teachers preparing WebQuest activities, the quality and limitations of these activities, and their mathematical contexts. The effect of WebQuest on the professional development of pre-service teachers is an issue waiting to be researched.

In-Service Teachers:

The studies have also been conducted on the impact of WebQuest on teachers' professional development and its applicability in the classroom. The teachers' competences in preparing webquests, WebQuests' effect on their teaching anxiety levels are still research questions.

These results underscore the need for further research into the effects of WebQuest in mathematics education across different student and teacher groups, highlighting the potential for significant contributions to the literature.

Limitations and Suggestions for Further Research

This study examines the studies on WebQuest in mathematics education. By determining the trends of the studies carried out in different fields and trends in the related field can be revealed. In this study, the descriptive features of the studies in the mathematics education literature were revealed through a systematic literature review. Further studies can be evaluated through meta-analysis and meta-synthesis analysis.

Ethics Committee Approval: Ethics committee approval was obtained from Balıkesir University Science and Engineering Sciences Ethics Committee (Date: 28.02.2023, Number: E-19928322-108.01-235510).

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