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Examining Non-Science Majors' Knowledge of Scientific Practices in Evaluating Scientific Media Claims*

Filiz Bezci¹ Semra Sungur²

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Research article

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Abstract

This study examines the knowledge of scientific practices that non-science undergraduate students need to critically evaluate scientific claims in the media. Employing a cross-sectional quantitative research design, the study gathered data through a self-report instrument involving 266 undergraduate students from non-science disciplines. A twelve-item, two-tier multiple-choice assessment was utilized, featuring questions from two research articles adapted from popular media. Findings reveal that non-science majors often struggle to understand the scientific practices necessary to evaluate scientific reports in mainstream media. Results also indicate that many participants fail to recognize the importance of controlled, randomized experimental designs in establishing cause-and-effect relationships. Additionally, findings suggest that students do not fully grasp that hypotheses are supported by evidence rather than proven and that scientific claims must be based on substantial proof. The study further shows that many participants underestimate the importance of peer review in validating scientific claims. Finally, the analysis revealed no significant gender differences in students' competencies related to critiquing these reports.

Keywords: Evaluating scientific claims, non-science majors, popular media, gender.

*Portions of the data utilized in this study were previously presented as an oral presentation at the European Conference on Educational Research. The present study extends the analysis with a different focus.

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Introduction

Scientific literacy is essential in today's education, enabling individuals to critically assess scientific claims, make informed decisions, and actively engage in scientific discussions (National Research Council [NRC], 2012; Osborne, 2014). As science becomes increasingly intertwined with societal and technological developments, it is vital to understand how scientific knowledge is created, validated and communicated (Busch & Rajwade, 2024; Lederman, 1992; McComas, 1998; Rudolph, 2023; Sjöström, 2024). A fundamental framework for promoting scientific literacy is the Nature of Science (NOS), which sheds light on scientific knowledge's philosophical, methodological, and social aspects (Erduran & Dagher, 2014; Osborne et al., 2003). However, scientific literacy is not merely an abstract understanding of NOS but also requires active engagement with scientific practices that emphasize how knowledge is constructed and refined through inquiry, experimentation, and critical evaluation (Bybee, 2011; Duschl & Grandy, 2013). While NOS has mainly been viewed as a theoretical concept in the past, current conversations in science education emphasize the significance of scientific practices that focus on how knowledge is constructed and refined (Busch & Rajwade, 2024; Matthews, 2015; Osborne, 2014; Rudolph, 2023). Scientific practices encompass formulating hypotheses, designing controlled experiments, analyzing empirical data, and deriving conclusions based on evidence (Next Generation Science Standards [NGSS] Lead States, 2013; NRC, 2012).

Furthermore, scientific literacy goes beyond just grasping scientific concepts; it also encompasses the ability to critically engage with science-related information within public discussions. The growing influence of mass media and digital platforms in shaping how the public perceives science makes it crucial to distinguish credible scientific claims from misinformation (Norris & Phillips, 2003; Pellechia, 1997). In particular, scientific literacy in the media era necessitates a deep understanding of scientific practices to critically assess claims in journalistic reports. Individuals must discern between methodologically sound research and sensationalized interpretations of scientific findings (Rosenthal, 2020). Developing critical reasoning skills in science education is key to preparing students to navigate the complexities of media-reported scientific findings, ensuring that they can evaluate sources, assess evidence, and interact with scientific information knowledgeably (Cavagnetto & Hand, 2012). This ability requires familiarity with essential scientific practices such as differentiating correlation from causation, understanding the significance of peer review, and evaluating the validity of sample sizes in experimental research (Leung et al., 2017).

The capacity to critically evaluate scientific claims is influenced by various factors, including one's educational background, confidence in scientific reasoning, and broader societal contexts (Eccles, 1987; Wang & Degol, 2017). Notably, gender differences in scientific engagement have been widely recognized (Cheryan et al., 2017). These differences underscore the need to explore how students from diverse backgrounds and experiences develop the essential skills to engage critically with scientific information in a world where science and society are increasingly interconnected. By integrating scientific practices into educational settings, students can be better equipped to assess scientific claims in a world saturated with science-related media, enabling them to participate in informed discussions and make evidence-based decisions (Strimaitis et al., 2014).

Literature Review

The Role of NOS in Advancing Scientific Literacy

NOS underscores the ever-evolving character of science, highlighting its provisional nature as it adapts to new evidence and refined methodologies (Kuhn, 1996; Shearmur, 2006). At its core, it emphasizes that scientific conclusions are grounded in empirical evidence, relying on systematic observation and experimentation to establish their reliability (Chalmers, 1999; Hanson, 1958; Osborne et al., 2003). Furthermore, NOS draws attention to the creative and inferential aspects of scientific practice, showcasing how human ingenuity and interpretation play critical roles in formulating hypotheses and designing experiments (Driver et al., 1996; Lederman, 1992). It also acknowledges the socio-cultural context in which science operates, recognizing that scientific advancements are deeply intertwined with the societal and cultural conditions that shape them (Kuhn, 1996; Shapin, 1995). Recent discussions in science education emphasize the necessity of integrating scientific literacy with socio-political and

ethical dimensions, ensuring that science is understood within its broader societal framework (Sjöström, 2024).

A fundamental aspect of NOS is its distinction between observations and inferences. Observations arise from direct sensory experiences, while inferences stem from interpreting these observations (Hanson, 1958). Additionally, NOS clarifies the roles of scientific laws and theories, explaining that scientific laws describe phenomena, whereas theories offer frameworks for understanding them (McComas, 1998). Grasping these distinctions is vital for science education, as it influences students' understanding of how scientific knowledge develops and operates within society.

Traditionally, NOS has focused on scientific knowledge's epistemological and philosophical foundations, but its role in science education has evolved over time (Rudolph, 2023). Traditionally, NOS has focused on the epistemological and philosophical foundations of scientific knowledge, but recent discussions increasingly spotlight the role of scientific practices in generating and validating this knowledge through established methodologies (Matthews, 2015; Osborne et al., 2003). While earlier frameworks primarily examined the philosophical dimensions of science, contemporary approaches have begun to advocate for a more integrated view that includes scientific practices as a crucial element of NOS. The Family Resemblance Approach (FRA) to NOS posits that these practices are integral and distinct within this framework (Irzik & Nola, 2011). FRA conceptualizes NOS as a multidimensional construct, weaving scientific methods, social dynamics, institutional norms, and historical context into a cohesive understanding (Erduran & Dagher, 2014). Recent studies further highlight the importance of understanding NOS as a community-driven construct, where scientific literacy is shaped by public engagement with scientific information and its social implications (Busch, 2024).

Incorporating this perspective into science education helps bridge the gap between understanding science theoretically and applying it in practice. This viewpoint highlights the dynamic nature of scientific inquiry and the myriad factors that influence scientific knowledge. When students engage in scientific practices, they develop a deeper appreciation for these processes and recognize the importance of evidence-based reasoning when evaluating scientific claims. Moreover, the evolving role of NOS in education underscores the necessity of equipping students with critical analytical skills to navigate misinformation and scientific discourse effectively (Donley, 2024). Ultimately, NOS serves as a foundational framework that enables students to grasp the complexities of scientific knowledge and its development, while fostering critical reasoning and informed engagement with scientific claims.

The Role of Scientific Practices in Advancing Scientific Literacy

Integrating scientific practices into educational frameworks effectively supports the primary objective of fostering scientific literacy (Duschl & Grandy, 2013; Osborne, 2014). Scientific literacy is cultivated through conceptual understanding and active engagement in scientific reasoning and evidence evaluation (NRC, 2007; 2012). In an era marked by rampant misinformation, equipping students with the skills for critical engagement with scientific discourse is essential (Cavagnetto & Hand, 2012). Science education, therefore, increasingly embeds scientific argumentation and critical evaluation within its curricula, enhancing students' competencies in analyzing and assessing scientific claims.

The adoption of scientific practices is reflected in various curricular standards, such as the Framework for K-12 Science Education (NRC, 2012). Through this framework, students engage in scientific and engineering practices such as inquiry, data analysis, and evidence-based argumentation. Crosscutting concepts like patterns, cause-effect relationships, and systems thinking further enhance their ability to connect insights across disciplines and foster holistic reasoning (Duschl & Bybee, 2014; NRC, 2012). Disciplinary core ideas anchor science in real-world contexts, addressing societal challenges like energy conservation and ecosystem dynamics while illustrating scientific knowledge's practical and ethical relevance (NGSS Lead States, 2013; McComas, 1998). By integrating these dimensions, students develop the ability to evaluate scientific claims critically, comprehend the evolving nature of inquiry, and recognize its broader societal impact, ultimately fostering scientific literacy and informed decision-making in an ever-advancing, technology-driven world (Krajcik et al., 2008; Kuhn, 1996). This integration ensures that students understand what science is and acquire the ability to think and act scientifically.

Proficiency in science necessitates a solid foundation in understanding, applying, and interpreting scientific explanations. This skill set is developed by constructing and evaluating scientific reasoning and evidence and understanding how scientific knowledge advances. Active participation in scientific discourse and practices is also crucial (NRC, 2007). Scientific literacy involves a mastery of scientific content and the capacity for critical engagement with scientific claims. This critical engagement requires understanding the processes by which scientific knowledge is produced, validated and communicated (Lederman et al., 2014; Strimaitis et al., 2014). Scientific practices can be categorized into two primary components (Matthews, 2015; Okasha, 2002). The initial discovery component involves observing, developing hypotheses, and systematically gathering, analyzing, interpreting, and showcasing data. This multifaceted process employs both inductive and deductive reasoning to ensure a thorough examination of scientific phenomena. The second component, justification, involves articulating how data are interconnected with various theories or hypotheses and advocating for prioritizing specific evidence over alternative information. Integrating these components into science education fosters analytical thinking, equipping students to navigate scientific claims in an increasingly media-driven world. Strimaitis et al. (2014) emphasize that proficiency in these "scientific practices" is essential for people to critically assess scientific assertions presented in mainstream media.

By embedding scientific practices into educational frameworks, students are better prepared to navigate the complexities of scientific information in a rapidly evolving media landscape. This approach enhances their analytical and reasoning skills and empowers them to make informed decisions and actively engage in societal and scientific discourse.

The Role of Media in Scientific Practices in Advancing Scientific Literacy

Scientific literacy is crucial in modern society, where media is a primary vehicle for disseminating scientific information. However, the increasing prevalence of scientific misinformation, particularly on digital platforms, has raised concerns about the public's ability to critically assess scientific claims (Cinelli et al., 2020; Gabarron et al., 2021; Norris & Phillips, 2003; Pellechia, 1997). Effective science communication requires cognitive engagement with empirical data and an understanding of the broader socio-political and economic influences on scientific discourse (Happer & Philo, 2013; Leung et al., 2017). Scientific literacy extends beyond basic comprehension of scientific concepts; it encompasses the ability to critically evaluate, interpret, and apply scientific knowledge in diverse contexts, including personal decision-making and public policy debates (Korpan et al., 1997). While media can enhance public understanding of scientific topics, it also plays a role in disseminating misinformation (Ahmed & Rasul, 2022; Rosenthal, 2020). Studies indicate that non-science majors often struggle to critically assess scientific claims presented in the media, emphasizing methodological rigor more while overlooking the broader social and institutional factors that shape scientific research (Leung et al., 2017).

The digital age has amplified these challenges, reinforced cognitive biases and created information silos through algorithmically curated content (Farhoudinia et al., 2024; Happer & Philo, 2013; Rosenthal, 2020). The rapid spread of misinformation, particularly in health and environmental sciences, has eroded public trust in scientific institutions and contributed to the proliferation of conspiracy theories (Cinelli et al., 2020; Gisondi et al., 2022). The COVID-19 pandemic underscored the detrimental effects of misinformation, with social media platforms facilitating the circulation of false claims regarding vaccines, treatments, and the nature of the virus itself (Ahmed & Rasul, 2022; Gabarron et al., 2021). This phenomenon, often referred to as an "infodemic," highlights the necessity of fostering critical evaluation skills to navigate the overwhelming volume of both accurate and misleading scientific information (Cinelli et al., 2020; Gisondi et al., 2022; Martins et al., 2018). Misinformation thrives in environments where cognitive biases, such as confirmation bias, are reinforced through selective exposure to ideologically aligned content (Ahmed & Rasul, 2022). Additionally, research suggests that emotionally charged misinformation, particularly content designed to evoke fear or distrust, spreads more rapidly than factual scientific information, complicating public engagement with credible sources (Farhoudinia et al., 2024; Happer & Philo, 2013).

Individuals' ability to critically evaluate scientific claims is shaped by cognitive and contextual factors. Research shows that those without formal science training tend to rely on superficial indicators of credibility, such as methodological transparency and sample size, rather than examining epistemological

concerns, such as funding sources, institutional affiliations, and peer-review processes (Korpan et al., 1997; Leung et al., 2017). Conversely, individuals with higher levels of scientific literacy demonstrate greater scrutiny of the credibility of sources and the mechanisms that regulate scientific knowledge production (Cinelli et al., 2020; Korpan et al., 1997). One of the major challenges in scientific communication is the oversimplification of complex scientific topics, often in an effort to make them more accessible to a general audience (Rosenthal, 2020). While simplification aids engagement, it can also foster misconceptions regarding the nature of scientific inquiry, particularly its tentative and evolving nature. Additionally, frequent exposure to misinformation in digital media has been linked to an increased likelihood of engagement with misleading content, particularly when it is framed in a way that aligns with pre-existing beliefs (Ahmed & Rasul, 2022; Happer & Philo, 2013).

Popular media consistently report on scientific research, and these reports serve as an essential foundation for public science education (Grandy, 1995; Wellington, 1991). The evaluation of scientific reports plays a significant role in shaping professional and personal decisions, influencing choices such as medical treatments and participation in socio-scientific debates, including those surrounding nuclear power and climate change policies (Cinelli et al., 2020; Norris et al., 2003; Pellechia, 1997; Zimmerman et al., 1998). A fundamental objective of compulsory education is to develop scientifically literate individuals capable of critically analyzing science-related media reports (Millar, 2006). If successfully implemented, such educational initiatives can enable all citizens, regardless of academic background, to engage with scientific information discerningly (Happer & Philo, 2013; Martins et al., 2018).

The interplay between media and scientific literacy is increasingly complex in a digital landscape where misinformation is prevalent. While media platforms serve as crucial spaces for public engagement with scientific concepts, they also present significant challenges in ensuring the accuracy and integrity of the information they distribute. In this context, the present study explores how non-science majors engage with scientific claims presented in media, identifying the key factors that shape their evaluation processes and the extent to which they consider methodological rigor and the broader societal context of scientific information. By doing so, this research seeks to contribute to developing more effective educational interventions that enhance students' ability to critically engage with science in media environments.

The Role of Gender in Scientific Practices in Advancing Scientific Literacy

Media portrayals of scientific research influence public understanding and perpetuate gender stereotypes in science engagement. Social perceptions of science, shaped in part by media representation, contribute to gender disparities in self-efficacy, interest in science, and reasoning skills (Eccles, 1987; Nisbett, 1993). Relevant research demonstrates that the gender gap in science is primarily due to environmental factors rather than genetics. Tindall and Hamill (2004) pointed out that girls and boys are raised under different ecological conditions starting from birth. Recent studies reinforce this notion, highlighting that societal norms and cultural expectations shape gendered play experiences, which, in turn, influence skill development and academic interests (Wang & Degol, 2017). Williams and George-Jackson (2014) further highlight that the underrepresentation of women in STEM is often linked to systemic cultural and institutional barriers rather than innate ability differences. For example, boys often engage in activities such as constructing models and solving puzzles, promoting their mathematics and science abilities, while girls participate in activities like drawing, sewing, playing house, and creating stories that enhance interpersonal, verbal, and fine motor skills (Aldridge & Goldman, 2002; Weisgram & Bigler, 2020). These early experiences establish foundational differences in competencies and interests that persist into adulthood.

Furthermore, girls are frequently expected to display passive behaviors and depend on others, while boys are encouraged to be proactive and self-reliant. This conditioning often results in male-dominated dynamics in science classrooms, where boys take the lead in discussions and laboratory activities, while girls may assume more passive roles focused on observation, note-taking, or data recording (Guzzetti & Williams, 1996; Woolfolk, 1998). Huang (2012) conducted a meta-analysis on gender differences in academic self-efficacy and found that males exhibited higher self-efficacy in mathematics, computer science, and social sciences, while females showed higher self-efficacy in language-related fields. These findings further reinforce the argument that gendered experiences in early education shape long-term

self-beliefs and engagement in STEM fields. Studies indicate that these classroom dynamics are exacerbated by teacher biases, with teachers setting higher expectations for boys in science-related subjects and offering them more complex questions and corrective feedback, further reinforcing gender disparities in confidence and self-efficacy (Riegle-Crumb & Morton, 2017; Master et al., 2016). Additionally, Hackett and Betz (1981) argued that the differing socialization experiences of boys and girls significantly affect their confidence in science. Recent research supports this, showing that girls often internalize societal stereotypes about gender and STEM (science, technology, engineering, and mathematics), leading to lower self-efficacy even when they perform equally well or better than boys in science courses (Cheryan et al., 2017). These disparities highlight the need for targeted educational interventions to create equitable opportunities for all students to actively engage in science and overcome entrenched societal biases.

To address these gender disparities, it is essential to implement educational interventions that challenge societal stereotypes and promote equity in science education. Encouraging inclusive classroom dynamics, providing equal opportunities for active participation, and fostering confidence in scientific reasoning among all students can help mitigate the effects of early socialization and biases. Such efforts are critical for ensuring that both boys and girls are equally prepared to engage in scientific practices and contribute meaningfully to the advancement of scientific literacy.

Significance of the Study

Scientific practices are a fundamental component of scientific literacy, particularly in an era where digital information is rapidly disseminated, requiring individuals to critically evaluate scientific claims (Busch & Rajwade, 2024; NRC, 2012; Rosenthal, 2020). The ability to engage with scientific reasoning is not only essential for those in scientific disciplines but is also crucial for non-science majors, who frequently encounter scientific information in everyday decision-making contexts. This study addresses a critical gap by investigating how non-science majors engage with scientific practices when assessing scientific claims presented in mainstream media.

The significance of this study lies in its focus on the role of scientific practices in enhancing media-based scientific literacy. While many studies have examined general scientific literacy, few have explored how non-science students develop the ability to critically evaluate scientific claims through engagement with scientific practices. Understanding these gaps is crucial for refining science education and ensuring that all students, regardless of their field of study, acquire essential reasoning skills necessary for informed decision-making (Osborne & Dillon, 2008; Tytler, 2007).

This study contributes to the broader discourse on science education by emphasizing the need for instructional strategies that integrate explicit engagement with scientific practices. Traditional curricula often emphasize factual knowledge at the expense of skills such as hypothesis testing, experimental design, and data interpretation (Duschl & Bybee, 2014; Lederman & Druger, 1985; Martin-Dunlop, 2013; Osborne, 2014). By investigating the challenges faced by non-science students in these areas, this research provides empirical support for curriculum reforms that promote inquiry-based learning and hands-on scientific engagement (Abd-El-Khalick et al., 2004; Martin-Dunlop, 2013).

Another key contribution of this study is its examination of potential demographic influences, such as gender, on students' engagement with scientific reasoning. Although prior research suggests that early socialization and educational experiences shape students' confidence in engaging with scientific discourse (Carli et al., 2016; Cheryan et al., 2017), findings from this study can help inform equitable science education practices that support diverse student populations (Williams & George-Jackson, 2014).

In summary, this study is significant for its focus on bridging the gap between theoretical scientific literacy frameworks and their practical applications in real-world decision-making. By identifying the challenges non-science majors face in engaging with scientific practices, this research informs future curriculum development and instructional strategies.

Purpose of the Study

The primary objective of this study is to investigate the scientific practices that non-science major undergraduate students need to critically evaluate scientific claims in the media. This includes their

understanding of hypothesis testing, experimental design, the role of peer review, and the ability to differentiate correlation from causation. Additionally, the study explores whether gender differences exist in students' ability to critically assess scientific claims.

Research Questions

The current research initiative is designed to address the following essential research questions.

- 1) What level of scientific practice knowledge is required for non-science major undergraduate students to effectively and critically assess scientific claims presented in the media?
- 2) Is there a gender distinction regarding the scientific practice knowledge required among non-science major undergraduate students to critically assess scientific claims presented in media?

Method

Participants

Participants were randomly selected from a public university in Turkey's Western Black Sea region, representing a spectrum of educational and socioeconomic backgrounds. The final sample comprised 266 undergraduate students enrolled in non-science major programs, categorized as follows: Turkish Language and Literature (28.2%), Philosophy (24.4%), Sociology (20.3%), Geography (19.2%), History (13.9%), and a small fraction from other disciplines (2.6%) (refer to Table 1). Among the participants, 186 were female and 79 were male, with ages spanning from 21 to 27 years ($M = 23.20$, $SD = 1.12$). The majority of students had completed their secondary education at General High Schools (45.9%) and were predominantly from Social Sciences and Humanities Tracks (50.9%). The average cumulative Grade Point Average (cGPA) of the cohort was 2.86 ($SD = .39$). Importantly, all participants reported no prior enrollment in science-related coursework or any studies related to the nature of science during their undergraduate tenure.

Table 1.
Demographic Information and Media Usage Preferences

Variables		Frequency (N)	Percentage (%)
Gender	Female	186	69.9
	Male	79	29.7
Department	Turkish Language and Literature	75	28.2
	Philosophy	65	24.4
	Sociology	54	20.3
	Geography	51	19.2
	History	37	13.9
	Other	7	2.6
High School Type	General High School	122	45.9
	Anatolian High School	70	26.3
	Vocational High School	45	16.9
	Religious Vocational High School	10	3.8
	Enhanced High School	2	.8
	Science High School	1	.4
	Other	15	5.6
High School Program Type	Social Sciences and Mathematics Track	124	46.6
	Social Sciences and Humanities Track	135	50.9
	Foreign Languages Track	1	.4
	Science and Mathematics Track	-	-
	Other	6	2.3
During Undergraduate Education, Courses Taken on	Science	No	266
		Yes	-
	Nature of Science	No	266
		Yes	-

Research Instrument

Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment: This study utilized the *Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment* to examine participants' ability to critically assess scientific claims presented in media, it was originally developed and validated by Strimaitis et al. (2014) within the framework of the NRC (2012) guidelines. Two real-world cases were incorporated into the assessment to assess students' ability to critically evaluate scientific claims in the media. The assessment instrument included two cases designed to evaluate students' ability to critically assess scientific claims presented in media reports. Each case was adapted from real-world research studies and focused on key aspects of scientific reasoning, empirical evidence evaluation, and methodological scrutiny.

The initial case investigated the biomechanical and musculoskeletal effects associated with prolonged use of high-heeled footwear. This examination was adapted from a study evaluating whether extended periods of wearing high heels adversely affect walking efficiency and musculoskeletal health. This case exemplifies how media framing can shape public interpretation of scientific findings, influencing the perceived credibility of health-related claims. Students were provided with a media report summarizing the findings of this research and were tasked with assessing the validity of its claims. In undertaking this evaluation, they were required to consider critical methodological aspects, including the existence of control and treatment groups, the adequacy of the sample size, and the differentiation between correlation and causation. This case encouraged students to critically assess whether the study sufficiently addressed potential confounding variables, such as pre-existing musculoskeletal conditions, variations in posture, or lifestyle factors that could influence the reported outcomes. Through this exercise, students engaged in a comprehensive analysis of experimental design and the evaluation of the strength of causal assertions within scientific media reports.

The second case study examined the potential health risks associated with energy drink consumption, requiring students to evaluate claims regarding the physiological effects of these drinks. This scenario was adapted from a published research article and presented a media report that summarized findings on both the short-term and long-term consequences of energy drink usage. Students were tasked with critically analyzing whether the claims made were substantiated by peer-reviewed scientific evidence, the rigor of the study's experimental design, and the validity of the conclusions drawn. This case encouraged students to consider whether the research accounted for variables such as pre-existing health conditions, individual differences in caffeine metabolism, and the possible influence of other lifestyle factors. Furthermore, students were required to assess the reliability of the reported claims by investigating the funding sources of the study, the peer-review status, and whether alternative explanations for the findings were adequately addressed. Both cases allowed students to apply critical scientific reasoning skills by evaluating the methodological soundness, reliability of evidence, and robustness of scientific conclusions derived from empirical data. Students were tasked with distinguishing between scientifically well-supported claims and potentially misleading representations of research findings in the media by actively engaging with these real-world examples.

Participants responded to a twelve-item, two-tiered multiple-choice assessment, in which each item consisted of two components. The first tier asked students to evaluate a specific scientific claim derived from the cases, while the second tier required them to justify their reasoning based on scientific principles. This structure provided insight into how non-science majors approach and justify their evaluations of scientific media claims. The first level assesses students' capacity to critically evaluate scientific claims, while the second level probes the reasoning behind their initial responses. This two-tier structure provides a deeper understanding of students' critical thinking and analytical skills. A single point is awarded only when both tiers of an item are answered correctly, ensuring that both the claim evaluation and the reasoning process are accurately assessed.

The scientific practices targeted by this assessment align closely with the core principles of scientific literacy, as summarized in Table 2. These include practices such as the importance of evidence-based claims, understanding the role of control groups in experimental design, and differentiating correlation from causation. For a detailed explanation of the original instrument and its development, refer to Strimaitis et al. (2014).

Table 2.

Scientific practices targeted by the instrument

Scientific practices	Items	Description
Scientific claims must be based on evidence	5B, 7A, 7B, 8A, 8B, 10B	Evaluate the sufficiency and relevance of evidence and reasoning provided to support scientific claims.
Scientific claims should be peer-reviewed	4A, 4B, 12A, 12B	Verify the credibility of scientific claims by confirming they have undergone expert peer review.
Manipulation experiments need control and treatment groups	3B, 6A, 6B, 9A, 9B	Assess the necessity of including control and treatment groups in experimental designs to ensure validity.
The sample size must support generalization of claim	1A, 1B, 2B, 10A	Determine whether the sample size is adequate for making reliable generalizations based on the study's findings.
Measurements have error associated	1B, 5B, 11A, 11B	Identify and account for potential errors in measurements when interpreting scientific results.
Hypothesis are supported, never proven	2A, 7A, 8A	Understand that scientific hypotheses are supported by evidence but cannot be definitively proven.
Correlation does not equal causation	3A, 3B	Distinguish between correlation and causation when analyzing relationships in data.
Axes on graphs can be manipulated to mislead	5A, 5B	Critically assess graphical representations to identify manipulations that could lead to misleading conclusions.

Validity and Reliability Analysis: The researcher of this article translated and adapted Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment to Turkish (The Turkish version of the instrument can be obtained upon request from the corresponding author). In this process, forward and backward translations were conducted by two subject-matter experts and a language specialist, and the results were compared to correct any conceptual meaning deviations. Subsequently, a pre-test was conducted with six students to evaluate their comprehension of the items and the alignment of their responses with the expected distribution. The validity and reliability of the scale were examined using data collected from 266 nonscience majors and 177 science majors, totaling 443 participants. This approach was adopted to provide a more robust and comprehensive understanding of the scale's psychometric properties. The reliability analysis yielded a KR-20 value of .846, indicating a high level of internal consistency for the scale.

Item difficulty and discrimination indices were calculated for single-tiered (Tier 1) and two-tiered items. The Tier 1 difficulty values ranged from .33 to .75, while the two-tiered difficulty values ranged from .21 to .42. These values demonstrate that the items varied in their level of challenge, with an appropriate spread across different difficulty levels. Discrimination indices for Tier 1 ranged from .21 to .85, and for two-tiered items, they ranged from .47 to .69, suggesting that the items effectively distinguished between higher- and lower-performing participants (Table 3).

Table 3.

Item difficulty and discrimination indices

Item number	Tier 1 only difficulty	Two-tiered difficulty	Tier 1 only discrimination	Two-tiered discrimination
1	.75	.41	.26	.57
2	.69	.42	.26	.47
3	.33	.21	.69	.59
4	.48	.32	.55	.60
5	.41	.27	.60	.58
6	.53	.41	.58	.64
7	.37	.24	.85	.69
8	.39	.29	.59	.54
9	.60	.40	.50	.55
10	.66	.37	.21	.54
11	.68	.38	.38	.51
12	.49	.31	.60	.55

Exploratory Factor Analysis as Validity Evidence: The EFA was conducted to evaluate the construct validity of the Turkish version of the Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment. The original scale comprises an 8-factor structure, and this analysis aimed to test whether the Turkish version aligns with the original factor structure. Accordingly, the number of factors was fixed at 8 during the analysis. Principal Component Analysis and Varimax rotation methods were utilized for the analysis.

The sample adequacy was evaluated using the KMO test, which yielded a value of .90, indicating excellent adequacy. Bartlett's Test of Sphericity demonstrated significant relationships among the variables ($\chi^2(276) = 1943.51$, $p < .001$), confirming the suitability of the data for factor analysis. The EFA results identified 8 factors, explaining 55.55% of the total variance (see Table 4). Factor loadings were generally consistent with the original factor structure. These findings provide strong evidence of the construct validity of the Turkish version of the scale. Importantly, no items were removed or added during the adaptation process.

Table 4.
Total Variance Explained

Factor	Eigenvalue	% Variance Explained	Cumulative % Variance
1	5.557	23.16	23.16
2	1.360	5.67	28.82
3	1.209	5.04	33.86
4	1.119	4.66	38.52
5	1.090	4.54	43.07
6	1.057	4.40	47.47
7	.987	4.11	51.58
8	.952	3.97	55.55

Data Collection and Analysis

This study employs a quantitative, descriptive research design utilizing a cross-sectional survey methodology. Data collection was conducted over a four-week period during the spring semester. Participants were recruited from undergraduate programs at a state university. Ethical approval for this study was obtained from the Çankırı Karatekin University Ethics Committee. Before the data collection began, students were provided with a detailed explanation of the study's objectives and ethical guidelines, including distributing and signing informed consent forms. Students completed two distinct components: a demographic information questionnaire and Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment. Both instruments were administered in a paper-and-pencil format under the supervision of the research team. Each session lasted approximately 30 minutes, with standardized instructions provided at the beginning to ensure consistent comprehension across all participants. Responses were securely stored and anonymized in compliance with ethical research standards for subsequent analysis.

Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment's reliability was assessed using the Kuder-Richardson Formula 20 (KR-20), yielding high internal consistency. Construct validity was evaluated through exploratory factor analysis (EFA), utilizing the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity. These analyses affirmed the data's adequacy and the items' alignment with intended latent constructs. Item difficulty and discrimination indices were also calculated to confirm the instrument's effectiveness in distinguishing between varying levels of participant performance.

Quantitative analysis was conducted to evaluate the collected data. Descriptive statistics summarized participant characteristics and performance. Descriptive statistics (mean scores and percentages) were used to summarize knowledge levels, providing a clear picture of overall performance and key areas of difficulty. Independent-sample t-tests were performed to investigate gender-based differences in critical evaluation skills.

Findings

Examination of Students' Knowledge of Scientific Practices

Findings revealed a significant gap in the participants' understanding of essential research methodologies. In particular, a striking 91% of participants were unaware of the essential importance of a controlled, randomized experimental study design for determining a cause-and-effect relationship, especially in the research focused on the risks linked to wearing high heels. This lack of awareness underscores a need for improved education on research principles among the participants (item 3B, see Table 5). The study involved nine women wearing high heels forty hours per week for at least two years and ten women wearing only flats. The walking efficiency of women was recorded. The women in the flat group walked barefoot, while women in the heels group walked both barefoot and in heels. The related item revealed that almost all participants (98.9%) failed to recognize a key limitation of the study. Based on the findings, it was impossible to claim that wearing high heels for forty hours per week over two years caused women to walk less efficiently than those wearing flats. This limitation arose because the study did not include a comparison group of women wearing flat shoes, randomly assigned at the beginning and end of the two-year period.

Table 5.
Participants' Responses to Individual Items

	Item Numbers	Incorrect (%)	Correct (%)	<i>M</i> *	<i>SD</i> *
Scientific claims must be based on evidence.	5B	54.1	45.9	.46	.50
	7A	90.6	9.4	.09	.29
	7B	73.7	26.3	.26	.44
	8A	79.3	20.7	.21	.41
	8B	66.2	33.8	.34	.47
	10B	70.3	29.7	.30	.46
Scientific claims should be peer-reviewed	4A	64.7	35.3	.35	.48
	4B	57.1	42.9	.43	.50
	12A	63.5	36.5	.36	.48
	12B	60.5	39.5	.39	.49
Manipulation experiments need control and treatment groups.	3B	91.0	9.0	.09	.29
	6A	58.3	41.7	.42	.49
	6B	46.2	53.8	.54	.50
	9A	48.5	51.5	.52	.50
	9B	54.9	45.1	.45	.50
Sample size must support generalization of claim	1A	29.3	70.7	.71	.46
	1B	67.7	32.3	.32	.47
	2B	45.9	54.1	.54	.50
	10A	33.1	66.9	.67	.47
Measurements have error associated.	1B	67.7	32.3	.32	.47
	5B	54.1	45.9	.46	.50
	11A	37.2	62.8	.63	.48
	11B	69.2	30.8	.31	.46
Hypotheses are supported, never proven.	2A	35.0	65.0	.65	.48
	7A	90.6	9.4	.09	.29
	8A	79.3	20.7	.21	.41
Correlation does not equal causation.	3A	89.8	10.2	.10	.30
	3B	91.0	9.0	.09	.29
Axes on graphs can be manipulated to mislead.	5A	75.6	24.4	.24	.43
	5B	54.1	45.9	.46	.50

*Statistics are obtained when correct answers are coded 1 and incorrect answers 0.

Many participants seemed to struggle with recognizing the essential role of peer review in validating scientific assertions. For example, only 36.5% correctly identified the Mayo Clinic Proceedings—a respected, peer-reviewed journal—as the most credible source for evaluating the concerns raised in an article about the dangers of energy drinks. In contrast, they mistakenly considered the New York Times and the University of Texas Health Center Bulletin equally qualified, revealing a notable gap in their understanding of reliable scientific assessment (item 12A, see Table 5). Only 19.5% of participants correctly answered both parts of the related question. They recognized the Mayo Clinic Proceedings as the most qualified peer-reviewed journal. They clarified their choice by noting that the journal evaluates claims through the expertise of multiple specialists in the field before publication (items 12A-12B, see Table 6). In the research about the risks associated with high heels, the feedback from students regarding the importance of peer review in assessing scientific assertions showed a steady pattern. Most participants (64.7%) believed that the most critical detail for assessing the claims was that the researchers belonged to the Musculoskeletal Research Program at Griffith University. Conversely, only 35.3% of participants correctly identified the importance of the research publication in the Journal of Applied Physiology from January 2012 as the key detail (item 4A, see Table 5). Furthermore, when analyzing responses across both levels, very few students (15.8%) were able to answer both questions correctly. This emphasizes the significance of publishing in a respected journal, suggesting that the research has undergone peer review by specialists in the field, which is essential for properly evaluating the claims (items 4A-4B, see Table 6).

The results indicated that most participants were unaware that hypotheses are not proven but instead supported by evidence. For example, in a related study concerning the dangers of energy drinks, a claim was made that "energy drink consumption has harmful side effects." Participants were asked whether this claim was substantiated by the evidence presented in the article. Only 3% of participants correctly recognized that the assertion concerning the dangers of energy drinks required further validation, as the long-term side effects remain speculative (items 7A-7B, see Table 6). In one of the items, participants were informed that the FDA does not regulate many of the ingredients present in energy drinks, as noted in the article. They were then asked about their perceptions of safety regarding these beverages. Notably, 33.1% of the participants incorrectly believed that a study examining how the ingredients in energy drinks compare to those in other foods would increase their sense of safety. Conversely, 66.9% correctly identified that multiple studies evaluating the side effects of these drinks on human health could enhance their feelings of safety (see item 10A in Table 5). Only a quarter of the participants (25.2%) answered a related question correctly, suggesting that they would feel safer if multiple studies were conducted to investigate the side effects of energy drinks on human health. They needed replicable evidence to validate these claims (items 10A-10B, see Table 6). This finding indicates that most participants lacked a clear understanding of the significance of evidence in scientific claims and the role of sample size in supporting broader conclusions. In fact, 70.3% of participants chose incorrect explanations regarding their responses to the first-tier question, which compared the value of multiple studies to examining ingredients in other foods. Specifically, they believed that they required evidence from a single study showing the presence of the ingredients, insights into teenagers' exposure to caffeine, or proof that at least one individual had experienced adverse effects from energy drinks (item 10B, see Table 5). Regarding measurement errors, 26.3% of students correctly recognized that a 95% confidence interval is appropriate in a study because complete control of human error is unattainable (items 11A-11B, see Table 6). The overall mean score on the Evaluating Scientific Claims: A Two-Tiered Multiple Choice Assessment instrument was 2.08 ($SD = 1.45$) out of a maximum of 12, with individual scores ranging from 0 to 6.

Table 6.
Participants' Responses to Both Tiers

Assessment Item Numbers	Construct	Incorrect (%)	Correct (%)
-1- 1A-1B	Sample size must support generalization of claim (1A +1B) Measurements have error associated (1B)	71.1	28.9

Table 6 continuing

-2- 2A-2B	Hypotheses are supported, never proven (2A) Sample size must support generalization of claim (2B)	67.7	32.3
-3- 3A-3B	Correlation does not equal causation (3A + 3B) Manipulation experiments need control and treatment groups (3B)	98.9	1.1
-4- 4A-4B	Scientific claims should be peer reviewed (4A+4B)	84.2	15.8
-5- 5A-5B	Axes on graphs can be manipulated to mislead (5A + 5B) Scientific claims must be based on evidence (5B) Measurements have error associated (5B)	89.1	10.9
-6- 6A-6B	Manipulation experiments need control and treatment groups (6A +6B)	73.3	26.7
-7- 7A-7B	Hypotheses are supported, never proven (7A) Scientific claims must be based on evidence (7A+7B)	97.0	3.0
-8- 8A-8B	Hypotheses are supported, never proven (8A) Scientific claims must be based on evidence (8A+ 8B)	85.3	14.7
-9- 9A-9B	Manipulation experiments need control and treatment groups (9A + 9B)	70.7	29.3
-10- 10A-10B	Sample size must support generalization of claim (10A) Scientific claims must be based on evidence (10B)	74.8	25.2
-11- 11A-11B	Measurements have error associated (11A + 11B)	73.7	26.3
-12- 12A-12B	Scientific claims should be peer reviewed (12A + 12B)	80.5	19.5

Examination of Gender Difference

A t-test for independent samples was performed to examine the knowledge of scientific practices needed for assessing scientific claims among male and female students. The findings revealed no significant difference, with male students achieving a mean score of 2.15 ($SD = 1.50$) and female students scoring a mean of 2.04 ($SD = 1.43$). The t-statistic was .56, and the p-value was .58.

Discussion, Conclusion, and Suggestions

The present research indicates that students not pursuing a science major frequently do not understand the scientific practices required to assess scientific reports in mainstream media with a critical approach. This finding aligns with prior studies suggesting that non-science students often struggle to apply scientific reasoning to real-world contexts, particularly when evaluating information presented in popular media (Leung et al., 2017; Strimaitis et al., 2014). This gap highlights a disconnect between the intended goals of science education and students' ability to critically evaluate scientific information.

Scientific Literacy and Science Education Challenges

The participants, non-science majors, in this study all underwent the same elementary and middle school science curriculum implemented nationally in Turkey. The Turkish curriculum is designed to be student-centered, emphasizing the skills, knowledge, and attitudes required for scientific literacy. Therefore, it was anticipated that all students would become well-informed consumers of scientific information, irrespective of their chosen major. However, despite these curricular objectives, students' ability to apply scientific reasoning in media-related contexts remains limited. Research suggests that this issue extends beyond Turkey and is a global concern, as science curricula often fail to fully integrate scientific practices into instruction (Osborne & Dillon, 2008; Tytler, 2007). Prior studies also indicate that science

curricula, even when well-designed, may not always be implemented effectively in classrooms, leading to gaps in students' ability to critically assess scientific information (Dindar & Yangın, 2007; Gökçe, 2006).

Science education in various contexts tends to rely heavily on didactic instruction rather than fostering inquiry-based, student-centered learning environments, which are essential for developing scientific literacy (Duschl & Bybee, 2014). For instance, Leung et al. (2017) found that students in traditional lecture-based science courses often struggle to differentiate between correlation and causation, an issue also observed in our study. Teachers often rely on lectures rather than fostering learning environments that promote active student participation. Consequently, students not majoring in science might not possess the understanding required to assess scientific assertions, which could stem from insufficiently executing the science curriculum at earlier educational levels. Science teachers need comprehensive training to effectively implement the curriculum, equipping students with the necessary skills and knowledge for informed personal, public, and professional decisions.

Scientific Practices and Their Role in Scientific Literacy

Comparing science majors to non-science students, it appears that the limited engagement of non-science students with scientific practices could result from differences in how science is taught and contextualized. Scientific practices, which include hypothesis generation, experimental design, and data interpretation, form the foundation of scientific reasoning (NRC, 2012). Research suggests that students develop these competencies through active engagement with scientific inquiry rather than passively absorbing factual knowledge (Osborne, 2014). However, non-science majors often receive limited exposure to these practices, primarily due to traditional instructional approaches prioritizing rote learning over inquiry-based exploration (Duschl & Bybee, 2014). Without direct involvement in the scientific process, students may struggle to evaluate the reliability of claims presented in mainstream media or scientific reports (Busch & Rajwade, 2024).

Research by McNeill and Krajcik (2008) emphasizes the importance of teaching scientific practices, such as constructing explanations and engaging in argumentation from evidence, to improve students' ability to critically evaluate scientific claims. Their study showed that students who received explicit instruction in scientific practices were better equipped to assess the credibility of scientific information, particularly in media contexts. Similarly, Osborne (2014) highlighted that structured opportunities to practice these skills through inquiry-based learning significantly enhance students' analytical abilities and confidence when engaging with scientific claims. These findings underscore the need for curricula integrating scientific practices into learning experiences, ensuring students develop the critical thinking skills necessary to navigate scientific information in everyday life.

Prior studies indicate that students grasp scientific reasoning more effectively when actively engaged in inquiry-driven learning and hands-on experimentation (Lederman & Druger, 1985; Martin-Dunlop, 2013). Inquiry-based learning approaches, which encourage students to ask questions, test hypotheses, and analyze data, have enhanced scientific literacy and improved students' ability to critically evaluate evidence (Abd-El-Khalick et al., 2004). However, traditional science curricula often fall short in incorporating these methods, particularly for non-science students, rarely providing structured opportunities to develop these skills. Project-based and hands-on science classes can potentially improve students' scientific reasoning, but their effectiveness largely depends on explicitly integrating key scientific concepts and practices. Simply implementing practical activities without addressing the foundational aspects of scientific reasoning may not significantly enhance students' understanding (Moss, 2001). This issue becomes particularly important when designing introductory science courses for non-science students. Studies suggest that integrating the history of science into instruction provides a meaningful context for scientific concepts, enabling students to critically assess the evolution and validation of knowledge within the scientific community (Matthews, 2015; McComas, 1998; Millar, 2006). Engaging in historical experiment replications and analyzing their outcomes fosters a deeper understanding of scientific inquiry, emphasizing its methodological rigor and broader social and epistemological implications. Integrating scientific concepts into educational materials across different subjects has the potential to contribute positively to students' scientific literacy. For example, incorporating scientific themes into English coursebooks has been shown to support scientific literacy

through interdisciplinary approaches, suggesting that similar strategies might be adapted for other subjects as well (Sağdıç & Yiğit, 2025).

Gender as a Demographic Factor and Scientific Practices

Gender is also analyzed as a demographic factor influencing the students' scientific practices. The lack of notable gender differences observed in this study aligns with previous research that highlights the importance of environmental factors such as early socialization, classroom experiences, parental expectations, and societal portrayals of science (Carli et al., 2016). For instance, Cheryan et al. (2017) emphasized that societal expectations significantly impact gender disparities in science participation, reinforcing self-perception differences rather than inherent cognitive ability gaps. Male students are often encouraged to take proactive roles in scientific discourse and laboratory activities, reinforcing their self-efficacy in conducting scientific inquiries (Schneider et al., 2015). Conversely, female students frequently face subtle biases that limit their participation, potentially shaping their long-term aspirations in STEM disciplines (Blickenstaff, 2005). Thus, while our study did not find gender disparities in scientific practices, educational interventions promoting gender-inclusive pedagogy remain necessary to ensure equitable access to scientific literacy skills (Williams & George-Jackson, 2014).

Contributions and Future Research Directions

The strength of this study is its focus on a relatively under-researched group. The study aims to contribute to the literature by identifying critical gaps in the scientific literacy of non-science majors, particularly concerning their ability to evaluate media-reported scientific claims. The findings obtained in this study align with recent work by Busch and Rajwade (2024), who emphasize the importance of bridging theoretical scientific knowledge with practical applications in media literacy education.

Future research should investigate how specific instructional strategies, such as integrating historical case studies of scientific discovery and utilizing interdisciplinary approaches, might enhance the ability of non-science students to evaluate scientific claims (Matthews, 2015). Additionally, longitudinal studies tracking students' development of scientific literacy over time could provide valuable insights into the long-term effectiveness of inquiry-based science instruction. Comparative research across different educational systems may further identify best practices for fostering scientific practices among non-science majors globally (Cinelli et al., 2020).

The reliance on a single institution limits the generalizability of reached findings. Expanding the sample to include participants from multiple universities across diverse geographic and academic contexts would provide a more robust understanding of the factors influencing non-science majors' scientific literacy. Additionally, qualitative research methods such as focus groups or interviews may yield deeper insights into students' reasoning processes and the challenges they face in evaluating scientific claims. By further refining science education to emphasize scientific practices, students can develop stronger critical thinking skills necessary for evaluating the increasing volume of scientific information disseminated through media platforms.

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Death Distress and Mental Well-being: Serial Mediating Roles of Meaning-Based Coping and Hope

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Abstract

While having an awareness of death may make life more meaningful for some individuals, it might also cause death distress for others. This study aims to understand the effects of death distress as an existential problem on mental health. A novel aspect of this study is the examination of the mediating roles of meaning-based coping and hope in this relationship. In the study, data were collected from 397 adults residing in 51 different Turkish provinces. The age range of the participants was 18 to 57 years old, and the average age was 24.39 years. ($SD = 5.42$). The participants participated in the study voluntarily through a web-based form. Using structural equation modeling (SEM) and the bootstrapping method, the relationships between variables were determined. All variables in the study were found to be related to each other. Additionally, as a result of the serial multiple mediation analysis, it was determined that meaning-based coping and hope played a full mediating role serially in the relationship between death distress and mental well-being. This finding indicates that death distress predicts mental well-being through meaning-based coping and hope. In conclusion, the findings indicate that meaning-based coping and hope have a beneficial and positive effect on reducing the negative impact of death distress on mental well-being.

Keywords: Mental well-being, death distress, meaning-based coping, hope, serial mediation analysis.

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Introduction

There is no doubt that no living being can escape death. The difference between man and other living things is that man is conscious of death and continues his or her life with this consciousness. Death distress is a kind of anxiety about the existence of an individual and might be experienced continuously in daily life. The death expectation contains different negative emotions and cognitions due to the existence of the person (Abdel-Khalek, 2004). Death distress can be defined as a concept that expresses a person's negative emotional reactions to death, attitudes towards death, fear, anxiety, restlessness, and awareness of death (Yıldırım & Güler, 2021). Al-Sabwah and Abdel-Khalek (2006) define death distress as a common human experience that consists of different negative concepts such as death anxiety, death depression, and death obsession. Dadfar et al. (2016), who developed the measurement tool for death distress, also emphasize that death distress consists of a combination of the mentioned factors. The difference between death distress, death anxiety, death depression, and death obsession is that death distress is based on experience. Individuals with a high level of death distress are likely to experience various mental health problems, such as feelings of inadequacy, anxiety, chronic stress, and depression (Menzies et al., 2019). In addition, studies in the literature reveal that death distress is associated with concepts such as resilience (Wen, 2010), well-being (Nagaraj & Nithyanandan, 2019), obsession (Abdel-Khalek, 2004), and suicidality (Lee et al., 2020). It is thought that death distress might cause negative mental health problems such as stress, dissatisfaction with life, impaired ego integrity, low resilience, and low well-being (Semenova & Stadlander, 2016). People who are in poor physical and mental health fear death more. This might play a role in increasing their death distress (Geurtsen, 2010). Various studies in the literature support that individuals with health problems experience more death distress (e.g., Depaola et al., 2003; Moreno et al., 2008). People who want to improve their well-being typically desire positive feelings. However, it cannot be said that they always succeed. Death distress is one of the negative emotions that individuals can experience throughout their lives. Almost every individual might be disturbed by the distressing situations that death can create. This negative situation created by the death distress on individuals can adversely influence their well-being. Menzies et al. (2019) emphasize that anxiety and depression might increase in individuals with death distress. On the other hand, Wen (2010) states that death distress negatively influences resilience. Various studies in the literature reveal the negative relationship of death distress with concepts such as life satisfaction, happiness, and well-being (Moreno et al., 2008; Nagaraj & Nithyanandan, 2019). From this point of view, it is thought that the fear of death has a negative effect on well-being.

While death distress is one of the important determinants of well-being, it is possible to talk about other determinants. Since well-being is a broad concept, various concepts that can influence the well-being of individuals can be mentioned. It is thought that one of them might be meaning-based coping.

Death and meaning are two concepts that are often studied together, especially through existential approaches. People might choose a goal for themselves to make life meaningful at some point in their lives. Meaning in life might be characterized as a person's recognition of consistency and order in his or her life, pursuit of the objectives that are significant to them, achievement of a goal, and the satisfaction felt as a consequence (Reker & Wong, 1988). This definition is based on Frankl's (1969) World War II traumas. In the afore-mentioned research emphasized the importance of creating meaning in life in order to cope with devastating traumatic situations. Based on Frankl's theories, Updegraff et al. (2008) emphasized that finding meaning in life plays an important role in post-traumatic recovery. It might be claimed that meaning-based coping mechanisms are based on this theory. Wenzel et al. (2002) defined meaning-based coping as "a positive re-evaluation and interpretation of a stressor". Hope (Feldman & Snyder, 2005), existential coping (Maddi, 2013), creative/proactive coping (Klein, 2017), meaningful activities (Schueller & Seligman, 2010), existential gratitude (Kleiman et al., 2013), and reframing (Park, 2010) are examples of meaning-based coping methods that have been based on research in the literature. Eisenbeck et al. (2022) state that the most effective of the meaning-based coping strategies are existential and creative/proactive coping strategies. Existential coping strategies are based on accepting the brutality of real life and building personal assumptions about the meaning of life. In this coping strategy, individuals try to cope with

challenging experiences with the help of the meaning they have built. In creative/proactive coping strategies, individuals aim to turn difficult experiences into a psychologically developmental advantage. They focus on how their experience will improve themselves by approaching the difficult events they have experienced from different perspectives (Wong et al., 2006). All these strategies mentioned are used as behavioral practices for meaning-based coping. This reveals that meaning-based coping is a behavioral strategy. In summary, it can be said that creating meaning in life is an effective coping strategy.

Meaning-Based Coping and Hope as Serial Mediators

Meaning-based coping is thought to have a significant role in increasing psychological resilience to traumatic experiences, protecting psychological health, and increasing immunity to chronic stress (McEwen, 1998). It might be claimed that meaning contributes an important function in overcoming stress and traumatic experiences. This significant function contributes to improved well-being and lower distress (Halama, 2014). Arslan and Yıldırım (2021b) state that meaning is associated with better coping and lower stress. Ellis et al. (2017) concluded in their research that meaning-based coping has a mediating and regulating effect on the relationship between mental health problems and well-being. When the literature is examined, it is possible to come across many studies on the positive effect of meaning-based coping on well-being (e.g., Arslan & Yıldırım, 2021a; Milman et al., 2020). All these findings reveal that meaning-based coping might be an important factor in reducing stress and increasing well-being.

While trying to understand the well-being of individuals in terms of death, another concept that is thought to have a role other than meaning-based coping is hope. When the factors that reduce the death distress of individuals are examined, it is seen that concepts such as hope, optimism, or self-esteem come to the fore (Soleimani et al., 2020). Hope can be defined as people's beliefs about reaching their goals and their tendency to exhibit various behaviors within the framework of these beliefs (Satici, 2016). There are various studies on hope, which is thought to be an important concept for the well-being of the individual (Gallagher & Lopez, 2009). Nadi and Sajjadian (2012) emphasized in their research that there is an important relationship among concepts such as well-being, life satisfaction, and hope. In another study examining the relationship among the concepts of resilience, well-being, and hope, the importance of hope in predicting well-being was mentioned (Munoz et al., 2020). Counted et al. (2022) also emphasized that individuals with high hope levels have higher well-being levels. It is possible to come across many studies that reveal this strong relationship between hope and well-being (Satici & Okur, 2022; Satici et al., 2023). Based on the relevant research, it might be concluded that hope is an important concept that contributes to well-being.

Models and Hypotheses

This research aims to reveal the serial mediator role of meaning-based coping and hope in the relationship between death distress and well-being. The concept of "death distress" is typically assumed to be connected to negative emotions. Death distress naturally causes various emotions and cognitions, which are mostly negative in individuals (Abdel-Khalek, 2011). The literature suggests that death distress, as an affective and cognitive response to mortality, has been consistently associated with adverse psychological outcomes, including impaired well-being (Abdel-Khalek, 2005; Feifel & Branscomb, 1973). These negative responses can create a barrier for individuals to engage in adaptive coping strategies, specifically meaning-based coping (Park & Folkman, 1997). Meaning-based coping, which involves positive reappraisal and finding significance in stressful experiences, has been linked to decrease psychological distress and enhanced hope (Folkman & Moskowitz, 2000). Emotions, thoughts, and behaviors related to death can prevent individuals from discovering the meaning of life and using coping strategies. In other words, individuals with high levels of death distress might have difficulty applying meaning-based coping strategies. As a result of this difficulty, individuals are likely to experience hopelessness. To conclude, since an individual experiencing death distress cannot use meaning-based coping, their level of hope might decrease, which negatively influences their well-being.

Hope itself functions as a crucial psychological resource that fosters goal-directed thinking, thereby contributing to better mental well-being (Snyder, 2002). In this sense, heightened levels of

death distress might undermine a person's capacity to utilize meaning-based coping, subsequently weakening hope, and ultimately reducing overall well-being (Folkman, 1997). By examining these constructs together, the present study extends the existing literature and provides a more holistic understanding of how death distress, meaning-based coping, and hope collectively influence well-being. All of this indicates that this research will offer important implications. When the literature is examined, although there are studies in which these concepts are examined separately, there is no study in which all the concepts are considered together. Therefore, it might be said that this research is important. In addition, the research is important in terms of revealing the serial mediator effect between the variables. All findings will further help explain the relationship between death distress and well-being. In this context, the hypotheses of the proposed research model for death distress, meaning-based coping, hope, and mental well-being are presented below:

H₁. Meaning-based coping will play a mediating role in the relationship between death distress and mental well-being.

H₂. Hope will play a mediating role in the relationship between death distress and mental well-being.

H₃. Meaning-based coping and hope will play a serial mediating role in the relationship between death distress and mental well-being.

Method

Participants and Procedure

The convenience sampling method was adopted in creating the sample for the study. The study group consists of 397 (303 [76.3%] female and 94 [23.7%] male) adults aged ranged 18-57 ($M=24.39$, $SD=5.42$) living in 51 different cities in Türkiye. The participants voluntarily participated in the study through a web-based questionnaire. The participants were asked to provide basic information (gender, age, and city of residence) as well as measures related to meaning-based coping, death distress, hope, and well-being. The sample's characteristics are shown in Table 1.

Table 1
Participants' Characteristics

Variable	Frequency	%
<i>Gender</i>		
Female	303	76.3
Male	94	23.7
<i>Educational status</i>		
High School or below	26	6.5
University	283	71.3
Master / Ph.D.	88	22.2
<i>Perceived Socio-Economic Status</i>		
Poor	98	24.7
Moderate	256	64.5
Good	43	10.8
<i>Employee Status</i>		
Student	199	50.1
Public Employee	71	17.9
Private sector employee	75	18.9
Unemployed	52	13.1

Measures

Meaning-Based Coping Scale. Eisenbeck et al. (2022) developed the Meaning-Based Coping Scale to assess people's meaning-based coping mechanisms. It is a seven-point Likert-type scale scored between 1 (strongly disagree) and 7 (strongly agree). The nine-item scale is a self-report scale (e.g., "I

believe this will yield a positive result"). The psychometric properties of the scale show that it is suitable for use in many cultures, including Türkiye. In this context, Cronbach's alpha value was reported as 0.86 in the reliability analysis (Eisenbeck et al., 2022).

Death Distress Scale. The Death Distress Scale was developed by Dadfar and Lester (2020) to measure the death distress of people. It is a five-point Likert scale scored between 1 (never) and 5 (always). The scale, which consists of three sub-dimensions, is a nine-item self-report scale (e.g., "I can't get the concept of death out of my mind"). The sub-dimensions of the scale are explained as death anxiety, death obsession, and death depression, respectively. Death anxiety is defined as individuals' intense and constant worry about death. Death obsession is when people constantly feel disturbed by death and have obsessive thoughts about it. Lastly, death depression is a serious mood problem that causes people's quality of life to decrease due to death and death-related thoughts. The adaptation of the scale to the Turkish sample was carried out by Yıldırım and Güler (2021). Internal consistency and reliability of the scale were calculated as 0.77 for the death anxiety sub-dimension, 0.88 for the death depression sub-dimension, and 0.91 for the death obsession sub-dimension.

Dispositional Hope Scale. Snyder et al. (1991) developed the Dispositional Hope Scale to measure people's level of hope. It is an eight-point Likert scale, scored between 1 (definitely false) and 8 (definitely true). The scale, which consists of two sub-dimensions, consists of four fillers and a total of 12 items (e.g., "My past experiences prepared me well for my future"). The adaptation of the scale to the Turkish sample was carried out by Tarhan and Bacanlı (2015). The Cronbach's alpha value, which was determined by the reliability analysis of the scale, was calculated as 0.84.

Warwick-Edinburgh Mental Health Scale. Tennant et al. (2007) developed the Warwick-Edinburgh Mental Health Scale to assess people's levels of well-being. It is a five-point Likert scale, scored between 1 (never) and 5 (always). The 14-item scale, which was at first translated into Turkish by Keldal (2015), was condensed into a seven-item form by Demirtaş and Baytemir (2019). This short form, which was also developed in this study, was used. The Cronbach's alpha value, which was determined by the reliability analysis of the scale, was calculated as 0.86.

Data Analysis

Data was collected in 2023 through an online form shared on various social media platforms. The form was designed so that participants who were at least 18 years old and agreed to participate voluntarily in the study could view the questions. Informed consent was obtained from each participant prior to data collection. No financial payments or rewards were given to participants during the study.

The initial evaluation of the data's suitability for parametric tests involved a normality test. After confirming that the data followed a normal distribution, descriptive statistics, correlation coefficients, convergent and discriminant validity, and reliability coefficients including McDonald's Omega, Guttman lambda, and Cronbach Alpha were calculated. IBM SPSS Statistics 26.0 and JASP 0.16.4 were utilized to perform descriptive statistics. The research questions were investigated using Structural Equation Modeling (SEM) in AMOS Graphics and a two-step approach, as suggested by Anderson and Gerbing (1988). First, the measurement model was evaluated, then the hypothetical model. Model fit indices included the standardized root mean square residual (SRMR), the root mean square error approximation (RMSEA), the comparative fit index (CFI), the normed fit index (NFI), the goodness of fit index (GFI), and the incremental fit index (IFI). Previous research suggests that the SRMR and RMSEA values should be less than 0.08, whereas the CFI, TLI, NFI, GFI, and IFI values should exceed 0.90 (Hoyle & Panter, 1995). For unidimensional scales, the parceling technique was used to reduce measurement errors due to a single factor (Little et al., 2002). Thus, WEMWBS and MCS were divided into two separate parcels. In addition, gender and age were accounted for as covariates in the study.

Ethics Statement

Before the research began, the Yıldız Technical University Social and Human Sciences Research Ethics Committee issued a certificate of ethical compliance (Report No: 20230402008, Verification Code: 7297f). At all stages of the study, the researchers adhered to the updated ethical

principles outlined in the Helsinki Declaration of 1975. Informed consent was obtained from all of the participants at the beginning of the study, and they were informed that the research results would be published. All participants in the research were volunteers, and no payment was made to the participants within the scope of the research. Volunteers who agreed to participate in the research filled out the research scales individually. Lastly, all participants were informed that they could withdraw from the study at any time.

Results

Preliminary Analyses

The descriptive statistics and correlations for the study variables are presented in Table 2. Positive associations were found between mental well-being and hope ($r=0.59, p<.001$), meaning-based coping ($r=0.58, p<.001$), and death distress ($r=-0.28, p<.001$). While hope correlated negatively with death distress ($r=-0.23, p<.001$), it correlated positively with meaning-based coping ($r=0.61, p<.001$). Also, there was a negative correlation ($r=-0.20, p<.001$) between meaning-based coping and death distress.

Statistical Assumption Tests

According to the study's findings, skewness values ranged from -0.444 to 0.286, and kurtosis values ranged from -0.195 to 0.124, satisfying the normality criteria. In addition, all coefficients of reliability were greater than 0.83, which is an acceptable level of internal consistency. They are presented in Table 2. There were no issues with multicollinearity and residuals, as the variance inflation factor values ranged from 1.06 to 1.68 and the tolerance values ranged from 0.60 to 0.94, with a Durbin Watson value of 1.88. As a result, Field's (2016) proposed hypotheses were all confirmed.

Serial Multiple Mediation Analyses

Initially, the measurement model was evaluated with four latent and nine observed variables. Indicators of model fit were favorable: $\chi^2(df=21, N=397)=55.76$, $\chi^2/df=2.65$; RMSEA=0.065, SRMR=0.044, GFI=0.970, TLI=0.964, CFI=0.979, NFI=0.967, IFI=0.979, AIC=103.768, and ECVI=0.262. All indicator factor loadings were significant, ranging from 0.68 to 0.98, indicating that each indicator adequately represented its corresponding variable. The factor loadings, mean, standard deviation, and reliability coefficients are presented in Table 2. According to the results, all factor loadings ranged between 0.46 and 0.97 and were statistically significant. The model had sufficient convergent and discriminant validity according to the standards proposed by Bagozzi and Yi (1988) and Fornell and Laeacker (1981). All of the coefficients of reliability were excellent ($\alpha>0.83$, $\omega>0.83$, and $\lambda_6>0.84$). In light of these findings, it was determined that the observed variables were reliable indicators of the latent constructs.

After determining that the measurement model was adequate, structural equation modeling was conducted. The partial model was evaluated with respect to the relationship between death distress and psychological well-being through the serial mediation roles of meaning-based coping and hope. Each fit index was acceptable [$\chi^2(df=37, N=397)=93.027$, $\chi^2/df=2.51$; RMSEA=0.062, SRMR=0.067, GFI=0.960, TLI=0.951, CFI=0.967, NFI=0.946, IFI=0.967] with the significant pathways. The pathway from death distress to mental well-being was found to be insignificant ($B=0.079, p>.05$). As a result, this pathway was eliminated, and a comprehensive mediation model was implemented. We observed acceptable fit indices for the full mediation model ($\chi^2(df=38, N=397)=95.812$, $\chi^2/df=2.52$; RMSEA=0.062, SRMR=0.070, GFI=0.959, TLI=0.950, CFI=0.966, NFI=0.945, IFI=0.966). It was also determined that each path was significant. Comparing partial and full models, the full model was selected due to the lack of significance of the direct path and quadrature in the partial model ($\Delta\chi^2=2.78, df=1, p>.05$). In the comprehensive mediation model, gender and age effects were accounted for. The results of the serial mediation analyses are depicted in Figure 1.

Table 2

Descriptive Statistics, Correlations and Reliability Values of Research Variables

Latent variables	Indicator	Loadings	<i>M</i>	<i>SD</i>	<i>Skewness</i>	<i>Kurtosis</i>	α	ω	λ^6	1	2	3
Death distress	DA	.46	10.71	2.98	.286	-.195	.86	.83	.90	–		
	DD	.83	9.26	3.60								
	DO	.62	6.24	3.53								
Meaning based coping	MBCP1	.97	25,50	5.37	-.444	-.043	.86	.86	.86	-.20*	–	
	MBCP2	.85	20,99	4.19								
Hope	AW	.71	25,06	3.91	-.365	.124	.83	.83	.84	-.23*	.61*	–
	AT	.84	22,68	4.22								
Mental well-being	MWP1	.88	14,35	3.08	-.377	-.025	.85	.85	.84	-.28*	.57*	.59*
	MWP2	.90	10,75	2.42								

DA death anxiety, DD death depression, DO death obsession, MBCP parcels of meaning-based coping, AW alternative ways, AT actuating thinking, MWP parcels of mental well-being. * $p < .001$

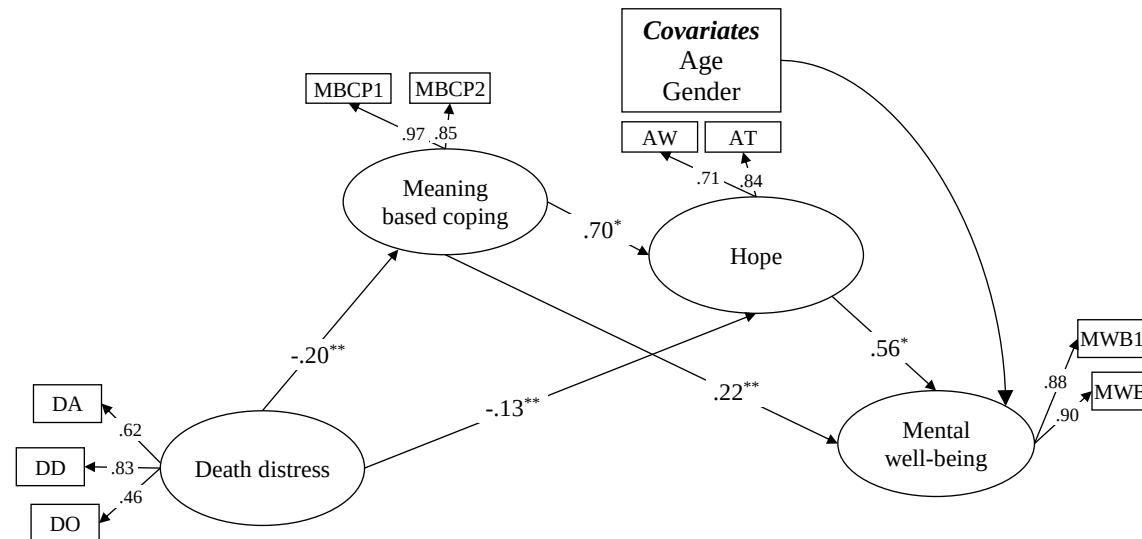


Figure 1. Structural Equation Modeling for the Serial Mediation Model.

Note. * $p < .05$, ** $p < .01$, DA: death anxiety, DD: death depression, DO: death obsession MBCP1: parcel of meaning based coping, MBCP2: parcel of meaning based coping, AW: alternative ways, AT: agency thinking, MWP1: parcel of mental well-being, MWP2: parcel of mental well-being.

Bootstrapping Analysis

We examined the statistical significance of the mediating variable utilizing 5000 bootstrap samples. This method generated confidence intervals (CI) for the indirect effects with a 95% level of assurance. Bootstrap 95 percent of non-zero confidence intervals were deemed statistically significant (Hayes, 2018). Meaning-based coping partially mediated the relationship between death distress and mental well-being (-0.085 , $p < .05$; BCa95% lower limit= -0.227 to upper limit= -0.010). Hope partially mediated the association between death distress and mental health (-0.143 , $p < .05$; BCa95% lower limit= -0.328 to upper limit= -0.021). The relationship between death distress and psychological health was fully mediated by meaning-based coping and hope (-0.151 , $p < .05$; BCa95% lower limit= -0.349 to upper limit= -0.042). The indirect relationships between variables are represented in Table 3.

Table 3
Indirect Effect of Serial Mediation Model

Path	Coefficient	95%CI	
		LL	UL
Death distress → Meaning based coping → Mental well-being	-.085	-.227	-.010
Death distress → Hope → Mental well-being	-.143	-.328	-.021
Death distress → Meaning based coping → Hope → Mental well-being	-.151	-.349	-.042

Note. CI confidence interval; LL lower limit; UL upper limit

Discussion and Suggestions

In this study, the role of meaning-based coping and hope as serial mediators in the relationship between death distress and well-being was investigated. Obtained findings are discussed and interpreted in detail below.

The first finding of this study shows that meaning-based coping has a full mediator role in the relationship between death distress and well-being. This means that meaning-based coping affects well-being positively by reducing the negative relationship between death distress and well-being. When the literature was examined, no study was found that examined the relationship among these three variables. The findings obtained from the studies examining the bilateral relations between the concepts support this finding of the research. It is possible to come across studies in the literature that reveal the negative relationship between death distress and well-being. Nagaraj and Nithyanandan (2019) revealed the negative relationship between death distress and well-being in their study.

Likewise, Semenova and Stadlander (2016) reached similar results. Various studies also reveal the positive effect of meaning-based coping on well-being. For instance, Arslan and Yıldırım (2021a) reported that meaning-based mechanisms increase optimism and reduce stress. From this point of view, it is thought that individuals who have a sense of meaning in life might have high levels of well-being. Based on various studies, it might be claimed that meaning-centered skills help manage stress in an individual's life, increase positive emotions, and strengthen resilience (Batthyany & Russo-Netzer, 2014; Hicks & Routledge, 2013). It is emphasized that meaning-based coping helps to increase psychological functionality and reduce distress (Halama, 2014). Another study focused on the effects of meaning-based coping on individuals with traumatic experiences (McEwen, 1998). According to this research, the effect of meaning-based coping on protecting mental health and reducing chronic stress has been revealed. Arslan and Yıldırım (2021b) also state that the stress level of individuals who apply meaning-based coping strategies decreases. These data show us that meaning-centered coping protects mental health by affecting various variables in an individual's life. In summary, the concept of meaning has an important influence on an individual's mental well-being. Based on all of the studies, it can be posited that the use of meaning-based coping strategies is associated with a reduction in death distress and a consequential enhancement of well-being.

According to the second finding of the study, hope plays a full mediator role in the relationship between death distress and well-being. In this finding, increasing the level of hope in the individual eliminates the negative effect of death distress on well-being. This finding is consistent with

the research in the literature. Although there are no studies in the related literature that deal with these three variables together, it is possible to come across studies examining bilateral relations. When the studies are examined, results supporting the second finding of the study are found. Previous studies have shown that higher hope levels play an important role in reducing negative emotions. For example, Arnau et al. (2007) emphasize that hope reduces negative emotions. In a similar finding, Wu et al. (2021) also state that as the hope level of individuals' increases, negative emotions such as death distress will decrease. The findings of Cheng et al. (2021) also support this. From this point of view, it might be interpreted that hope is a variable that reduces the distress of death. Numerous studies in the literature (Counted et al., 2022; Gallagher & Lopez, 2009; Satıcı et al., 2023) have also revealed the connection between hope and well-being. Wong et al. (2006) also stated that meaning-based coping has a positive role in increasing well-being. Based on these studies in the literature, it can be interpreted that hope reduces death distress and strengthens well-being.

In the third and main finding of this study, it was revealed that meaning-based coping and hope play a full mediator role in the relationship between death distress and well-being. In other words, the effect of death distress on well-being decreases when meaning-based coping and hope variables come into play. When the relevant literature was examined, no study was found in which these concepts were discussed together. For this reason, it is expected that this finding will make a unique contribution to the literature. Death distress is one of the important stressors that an individual may encounter during her/his daily life. When an individual encounters a stressor that they cannot cope with, meaningful coping strategies might be weakened. This can cause the person to lose their sense of meaning and experience hopelessness. In addition, it is possible for the individual to develop negative feelings about the future due to death anxiety. Developing negative emotions might lower the hope level of the individual. It is inevitable that the level of well-being of the individual whose meaning-based coping level and hope level decrease also decreases. Meaning-based coping is one of the most effective methods of coping with stress. It might be claimed that individuals with a high degree of meaning-based coping will not have difficulty managing the stressors they will encounter in their lives. From this point of view, individuals' participation in activities that will increase their meaning-based coping skills and hope levels might play an important role in increasing well-being by reducing death distress. Based on the findings of the research, it might be claimed that it will be effective to include activities that will improve meaning-based coping and hope in studies aiming to reduce death distress.

In addition to all these discussions, another important point to note in this study is that the participants are predominantly female adults. Therefore, the research findings should also be interpreted in terms of gender. Considering Turkish cultural characteristics, men and women have different emotional reactions to difficult life events. In Turkish society and similar cultures, women are likely to react more emotionally to positive and negative experiences (Güder & Kaya, 2023; Kandemir, 2020). For instance, women from Turkish culture tend to be more upset and react emotionally to death, while men prefer to remain silent and keep the pain inside. Thus, the findings of this study can be considered to reflect women's reactions in a cultural context. In other words, the results of this research enable us to better understand the emotional reactions of Turkish women within the cultural context and to realize through what factors mental well-being might be strengthened when experiencing death distress. Strengthening the meaning-based coping strategies of women facing the distress of death and enabling them to look at the future more positively will further protect their mental health.

To ensure the universal applicability of these findings, educational programs should be adapted to different cultural and social contexts. Programs designed to address death distress can incorporate culturally sensitive approaches that consider varying emotional expressions and coping styles across societies. For instance, in collectivist cultures, group-based interventions and community support systems might be more effective, while in individualist cultures, personal reflection and self-guided coping strategies could be emphasized. Developing flexible, culturally tailored psychoeducational programs will enhance their relevance and accessibility across diverse populations.

Limitations and Future Research

The present study has some limitations. The first limitation is that the study represents the Turkish sample. In future studies, conducting an intercultural study with data obtained from different cultures will ensure that the results are more comprehensive. The second limitation is that the sample group consists of adults. Obtaining the data used in the study from a specific group might reduce generalizability. Therefore, it should not be ignored that this study does not include adults. In future studies, using data obtained from individuals in different life periods will increase generalizability. The third limitation of the study is that it is a cross-sectional study. Cross-sectional studies are not as successful as longitudinal studies in clearly demonstrating the cause-effect relationship. Therefore, using the longitudinal methodology in future studies might be important in terms of revealing the long-term effects of the variables. The fourth limitation of the study is that the number of female participants in the study is higher than that of males. This might limit the generalizability of the findings across genders. In future studies, it is recommended that the gender distribution be more balanced and the effects of gender on the variables be examined in more detail.

The findings from the study suggest that meaning-based coping strategies and the enhancement of hope might be useful when working with individuals experiencing death anxiety by psychologists and counselors. In particular, meaningful-based coping and practices that increase hope can be used in interventions aimed at reducing death-related stress and increasing mental well-being. It can guide the development of policies to reduce the psychological effects of death. Future research can explore how these policies can be effectively implemented in educational settings, particularly through structured programs that promote resilience and coping skills. Additionally, studies can assess the long-term impact of meaning-based interventions on students' mental well-being, informing the development of evidence-based educational practices. Hope and meaning-based coping strategies can be used to relieve the emotional burden of individuals experiencing death distress. In this context, training programs for teachers and educators can be developed to equip them with the necessary skills to address death distress and teach coping strategies to students. These training sessions can include workshops on fostering resilience, emotional expression, and meaning-based discussions about loss and grief. Additionally, integrating modules on death awareness and coping strategies into teacher education curricula can help educators become more confident in addressing these topics in the classroom. Schools can also establish support systems, such as peer mentoring or counselor-led group discussions, to provide a safe space for students to process their emotions. Additionally, schools can integrate structured counseling services and dedicated support groups to help students navigate death distress. These services can include regular sessions with trained counselors, grief workshops, and peer support networks, ensuring that students have access to professional guidance and emotional support when needed. By incorporating these practices into educational settings, teachers and educators can play a crucial role in helping young individuals build emotional resilience and adopt positive coping mechanisms.

Conclusion

As a result, in this study, meaning-based coping and hope have a full mediating role in the relationship between death distress and mental well-being. In other words, death distress experienced by individuals predicts mental well-being through the mediating role of meaning-based coping and hope. This finding reveals that meaning-based coping and hope are effective in reducing the negative influence of death distress on mental well-being. Therefore, encouraging the search for meaning and the level of hope of individuals experiencing death distress might be an important factor in supporting and protecting mental health.

Some implications may be made based on these results obtained within the scope of the research. For instance, these results have important application potential for mental health professionals. When we consider the distress of death as a natural part of life, developing individuals' meaning-based coping skills and increasing their positive expectations for the future during the psychological counseling process can strengthen mental health. Mental health professionals can also guide people on developing hope and meaning-based coping mechanisms at the same time. In addition, integrating death distress and coping strategies into educational curricula through structured workshops or dedicated courses can provide individuals with the necessary tools to manage such

distress effectively. These educational initiatives can be incorporated into university counseling programs, mental health training, or even broader school curricula to promote emotional resilience from an early age. For all these, psychoeducational programs that might be developed and implemented by researchers are needed. Particularly for adolescents and young adults, these programs can be designed with age-appropriate content that incorporates interactive activities, group discussions, and real-life scenarios to help them develop meaning-based coping and hope. Schools, universities, and community organizations can collaborate with mental health professionals to integrate these programs into their curricula, ensuring accessibility and effectiveness. Additionally, digital platforms and mobile applications can be utilized to provide continuous support and resources for young individuals, enabling them to engage with coping strategies in a way that resonates with their daily experiences. These programs should ensure that individuals gain awareness of issues related to death distress and indirectly strengthen their mental well-being. Additionally, these programs might raise social awareness about death distress and mental health. Furthermore, educational institutions can collaborate with mental health professionals to design interdisciplinary courses that integrate psychological resilience, existential concerns, and meaning-based coping strategies, ensuring a holistic approach to mental well-being. Lastly, psychoeducational programs can provide training on meaning-based coping strategies and improve the level of hope. All of these might lead to a better understanding of the connection between death distress and mental well-being and increase individuals' meaning-based coping skills and level of hope in situations of death distress. It is believed that such activities will benefit people's mental health.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Training via Sandwich Education: How Stressed is the Counsellor Trainee?*

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Abstract

The voluminous study nature and the intensive structure of sandwich study mode masters-level counselling programmes might pose various unascertained stress levels to counsellor trainees. With a descriptive cross-sectional study design and a census survey, this study used the University Stress Scale (USS) to determine the prevailing stress levels among 92 Master of Education (MEd) counsellor trainees in a Ghanaian university. The study employed means with standard deviation and t-test to analyse the data set. The findings of the study indicated that counsellor trainees reported stress levels that predicted significant psychological distress. Also, some perceived stressors emerged as the major predictors of significant psychological distress. However, there were no statistical differences in the stress levels of men and women, those below 35 years and those that were 35 years and above, and, those in year one and those in year two of their studies. Thus, the study recommended that a stress-reducing and positive-coping strategy guide, encompassing age, gender and years in training, would improve the mental health of sandwich mode masters-level counsellor trainees. The study also recommended that the counsellor trainees practice self-awareness, self-assessment, and self-assistive strategies to identify and cope with their stressors and seek psychological help when necessary. The study suggested that university authorities and counsellor educators consider a Sandwich Hybrid and Blended Learning environment for counsellor training through a sandwich education mode.

Keywords: stress, sandwich education, counsellor training

* This article is produced from the first author's Master of Philosophy thesis titled 'Relationships among Counsellor Trainees' Emotional Intelligence, Stress and Empathy in a Ghanaian University'.

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Introduction

Counsellor training at the university gives trainees structured theoretical and practical learning experiences to usher them into the field of helping. During the training, counsellor trainees develop their 'self' and learn about clients and the techniques to help clients (Karaman et al., 2018; Moller & Rance, 2013). They acquire the theories needed for counselling, perfect research skills and how to administer and interpret psychological assessment tools. However, the period of counsellor training may pose a distressing experience for counsellor trainees. Slovak et al. (2015) asserted that a challenge among counsellor trainees is learning the complexity of interpersonal reflection in counselling skills development. Counsellor trainees also experience confusion, anxiety, excitement, curiosity, and fear during practicum (Dye et al., 2020; Hodges, 2016; Kurtyılmaz, 2015) (Hodges, 2016; Kurtyılmaz, 2015). Moreover, they endure the complex dynamics of privilege and oppression in the counselling training programme (Chan et al., 2018).

The sandwich education system was noted in engineering education among Scottish universities in the early nineteenth century, where engineering students spent six months each year in practical training in the office, the field, or the workshop. By the 1920s sandwich education was adopted as a standard form of earning national certificates and diplomas for technical courses in Scotland. The purpose was to mainly cater for part-time students in technical colleges that erupted in Scotland due to industrial demands for both theoretically and practically trained workers (Smithers, 2021). Sandwich education allows workers to study at a higher institution without a study leave while in active employment. The concept of sandwich education is to provide a tertiary education that combines academic work and practical work experience through an industrial placement, internship and employment. The system affords students the practicality to apply learned theoretical concepts gained at the university (Brooks & Timms, 2023; Dei & Peprah, 2021; Smithers, 2021). In Ghana, at the University of Education, Winneba, a sandwich mode of study enables some students, the majority in gainful employment, to come to campus for an intensive programme for a short period when regular full-time session students are on vacation.

Generally, the structure of sandwich education manifests lifelong university learning that caters for teachers' and education workers' education and training (Imakpokpomwan & Adeyemi, 2016; Okeke et al., 2021; Osuji, 2009). Sandwich education offers a wide range of courses of study to males and females aged 20-59 years (Adesoye & Amusa, 2010). Globally, sandwich education has been accepted and embraced by some prospective students and lifelong learners as a standard form of education (Manu et al., 2020). Thus, the demand for sandwich education admission and placement has increased worldwide (Ampomah et al., 2020; Imakpokpomwan & Adeyemi, 2016; Manu et al., 2020).

Sandwich students are prone to stress due to their study's short duration and intensive nature. Esia-Donkoh (2014) discovered that 56.6% of sandwich students experience acute stress, 28.6% of them experience chronic stress, and 14.8% experience episodic stress. Yorke (2000) found out that, some sandwich students could not complete their programme due to varied stressors. Stressors among sandwich students include limited facilities, learning difficulties, course outline challenges and unhealthy student-lecturer relationships were perceived as stressors. The rest are frequency of examinations, financial challenges, family/marriage problems misappropriation of time (Kayode & Adedokun, 2019; Kwaah & Essilfie, 2017; Nwosu et al., 2021; Ofuebe et al., 2021). Asante (2017) found that stress, sleep deprivation and eating disorders prone sandwich students to ailments and diseases such as upper respiratory infection, influenza, gastroenteritis, conjunctivitis, and meningitis.

Literature Review

Stress

Stress is a word from strain to depict hardship, straits, adversity, or affliction (Lazarus & Folkman, 1984). The phenomenon of stress is that people are responsive to threatening or challenging events (Feldman, 2009). Such events could be pleasant or unpleasant. Stress is inevitable in the life of all humans due to the complex and uncertain sequences of daily existence (Lazarus & Folkman, 1984; Robinson, 2018). The interdisciplinary nature and the diverse conceptualization of the phenomenon of

stress broadly contribute to a proliferation of definitions of the stress concept (Epel et al., 2018; Mohamed & Baqutayan, 2015).

Specific to this study, stress is a common nonspecific reaction to surrounding environment changes that posits in different ways and for varied reasons among individuals (Feldman, 2009; Greenberg, 2016). Lemyre and Tessier (2003) factored stress as a physical and mental disorder precipitator. However, it is less threatening when successfully coped with and adapted to. Thus, an ascertained stress in a particular environment might also be a pleasure in another setting (Mohamed and Baqutayan, 2015). Thus, what might be a positive stressor in an individual may be a negative stressor for another. Also, stress could exacerbate physical health when resisted unabatedly.

The demands of life that cause stress are universally called stressors. Selye (1956) coined the term to represent sources of potential stress (Szabo et al., 2012; Tennant et al., 1985). The signs of stress are thoughts, behaviours and feelings. Acceptably, signs of stress are present in physical, mental, and emotional categorisation (Adasi et al., 2020). While categorising them as physiological, emotional and behavioural, Lin and Yusoff (2013) asserted that they occur in a vicious cycle. Wheaton et al. (2013) defined stressors as existential or concurrent conditions that destabilize the functional integrity of an organism.

Tennant et al. (1985) categorized stressors into physical, psychological and psychosocial stimuli. Spielberger and Sarason (2005) labelled stressors as extrapersonal, interpersonal and intrapersonal. Greenberg (2016) identified developmental transitions, major life events, chronic stressors, daily hassles, trauma, and fallout from childhood experiences as types of stressors. Focusing on university students, Zegeye et al. (2018) and Amponsah and Owolabi (2011) categorized stressors into cohorts of physical, emotional, mental and spiritual. According to Spielberger and Sarason (2005), the identified stressors are interrelated. Thus, one stressor might elicit or complement other stressors. Therefore, managing a particular stressor may assist in successfully coping with related stressors.

Counsellor Trainee's Stress

The rubrics of counsellor training expect trainees to cope with multiple training demands such as coursework, research and practicum (Finlay-Jones et al., 2016; Malikiosi-Loizos, 2013). The pressure to academically impress lecturers and excite supervisors in therapy leads to socially unacceptable feelings. When trainees cannot adapt to such multiple demands in training, they are prone to stress (Richardson et al., 2018). Some trainees also experience stress due to their disabling biographies (Kumary & Baker, 2008). In unanimity, scholars have agreed that the development of personal change demands, professional skills development and strains for academic excellence make counsellor training a stressful event (Folkes-Skinner, 2011).

About 59% to 75% of trainee psychologists experience moderate to high stress (Cushway & Tyler, 1994). Reports of high and unacceptable stress levels among counsellor trainees are a repeated feature. Stress hinders their effective academic performance, practicum skills acquisition and personal well-being development (Myers et al., 2012). Kumary and Baker (2008) have wondered whether institutions purposely design counsellor training programs to expose trainees to unacceptable stress levels to assess their resilience to professional practice.

In categorisation, some counsellor trainees' stress is practicum-related, academic-related, and self-related challenges. For practicum-related challenges, Saki and Şahin (2021), Nike (2024), and Roebuck and Reid (2020) identified difficulty in self-sourcing for practicum sites, lack of opportunities to apply the knowledge acquired in class, and trainee's feelings of incompetence, sense of insecurity, communication with clients and lack of emotional resilience. Other stressors may include inadequate sleeping, fatigue, bullying from lecturers and supervisors, poor supervision, and long lecture hours and assignments. The rest are long distances to and from lectures and practicum, limited time and a lack of communication and teamwork (Richardson et al., 2018). Cushway and Tyler (1994) recognized four categories of stressors in psychology trainees. The stressors were academic, placement, organizational and personal. Those stressors were the basis for the Counselling Psychology Trainee Stress Survey (CPTSS) (Kumary & Baker, 2008). According to Varma (1997), six underlying factors that stressed

counsellor trainees were course structure and organization, workload and poor supervision. The rest were disruption of social support, self-doubt and client difficulties.

Stress gradually exposes counsellor trainees to apathy, emotional exhaustion, depersonalization and a decline in personal accomplishment (Makadia, 2016). Stress, coupled with other predisposition factors, induces depression. Prolonged stress among counsellor trainees causes burnout that makes them feel exhausted and dissatisfied, manifesting in their approach towards life and relationships with others and even cynicism toward life and others (Richardson et al., 2018). Burnout causes counsellor trainees not to trust the effectiveness of therapy. Thus, they shy away from clients when they experience burnout. However, Richardson et al. (2018) asserted that stress does not impede the competency development of a counsellor trainee.

Subhi et al. (2021) asserted that counsellor trainees cope with stress intelligently, especially in unavoidable situations such as the recent lockdowns due to the outbreak of COVID-19. Some strategies they used included planning their work and time, positive evaluation of themselves and others, accepting emerging situations and believing and practicing religion. Besides that, they sought emotional support, practiced denial and withdrew from stressful behaviours. Moreover, counsellor trainees express their feelings frequently, seek social care and engage in alcoholism and smoking to relieve themselves from stress.

Purpose of Study

Owing to the short and intensive nature of the academic period of sandwich students and its associated challenges at the University of Education, Winneba, sandwich students may experience significant levels of acute, chronic, and episodic stress. However, the stress levels of counsellor trainees studying a sandwich mode programme are vague. There seems to be no forthcoming study that has evaluated stress levels solely and their associated stressors among counsellor trainees at the University of Education, Winneba, Ghana. Thus, this study sought to find the stress levels and associated stressors among masters-level counsellor trainees studying a sandwich mode programme at the University of Education, located in Winneba in Ghana, to create awareness that would promote mental and physical well-being. Also, the study evaluated the mean difference in stress to determine the statistically significant differences between the average values of the groups within counsellor trainees' gender, age, and years in training. The comparison of the means would prove the reality or randomness between the groups, which will allow for informed conclusions and recommendations for accurate stakeholder interventions. The study outcome shall contribute to counsellor trainees' well-being and mental health in counsellor training literature. Also, it shall inform counsellor trainees and educators about the stress levels of counsellor trainees, and their associated stressors. This will enable counsellor trainees to decide whether to cope with their stresses, devise stress reduction mechanisms or seek psychological help from counsellor educators. It would also create a pathway for a scholarly discourse among counsellor educators and university authorities on stress-free learning environments in counsellor training.

Method

Participants and Procedure

We used a descriptive cross-sectional study design (Cohen et al., 2018; Creswell & Creswell, 2018) and a census survey (Kothari, 2004; Martínez-Mesa et al., 2014; Mathers et al., 2009) to collect single-point data to determine the prevailing stress levels among 92 out of 153 masters-level counsellor trainees who are studying for the 2021/2022 academic year on sandwich mode. Participation was voluntary. To reduce nonresponse in the survey, we employed the personally administered questionnaire and the collective administration methods to collect the data. However, since the participation was voluntary, 101 of the 153 counsellor trainees responded to the study instruments. During sorting for analysis, we identified that nine of the packs of questionnaires that they responded to were incomplete. Thus, the completed responses to the study instruments were 92. 92 respondents represent 60% of the total population of 153 masters-level counsellor trainees. 60% response rate constitutes an acceptable participation for a survey measure in a cross-sectional study (Denscombe, 2010; Fincham, 2008).

Of the respondents, 62% (n = 57) were women, and 38% (n = 35) were men. Also, 73% (n = 67) of respondents were 35 years and above, and 27% (n = 25) were below 35 years. For marital status, 64% (n = 59) of them were married, and 36% (n = 33) were not married. Accordingly, 53% (n = 49) of respondents were first-year students, and 47% (n = 43) were final-year students. Invariably, 87% (n = 80) of respondents were employed. Additionally, 13% (n = 12) were unemployed. Lastly, 86% (n = 79) were gainfully employed. The remaining 14% (n = 13) were searching for jobs.

Instruments

We used insensitive items to collect demographic data from the counsellor trainees (Bolarinwa, 2015; Lodico et al., 2010). Our focus was on counsellor trainees' sex, age, and years in training. Also, we adopted and used the University Stress Scale (USS) (Stallman, 2008; Stallman & Hurst, 2016), a 21-item screening measure, to gather information about the counsellor trainees' stress levels. The university Stress Scale is a 4-point Likert scale. Its responses and scoring are: not at all = 0, sometimes = 1, frequency = 2, and constantly = 3. An extent score, the sum of all items, which is ≥ 13 , predicts significant psychological distress. We pretested the University Stress Scale on 31 counsellor trainees randomly selected from the study population. The purpose is to know if there is a need to 'localize' the language of the University Stress Scale, determine its quality and ability, and ascertain the understanding and response latency of the trainees (Draugalis et al., 2008; Ikart, 2018). The responses obtained from the pretest were given to three language experts at the University of Education, located in Winneba, to ascertain if they constitute a valid participant language understanding of the University Stress Scale. The pretest outcome validated the acceptability of the study. The Cronbach alpha was .84.

Data Collection

After obtaining official permission from the appropriate establishments, we contacted and established rapport with the counsellor trainees during one of their official gatherings at the Faculty of Educational Studies, University of Education, Winneba, Ghana, a couple of days after the pretesting. We explained the need and purpose of the data to them, assured them of confidentiality, and made them consent to provide the data for the study. We provided an email address to request clarification or exclusion of data from the set before giving them a pack containing the University Stress Scale with the demographic items and a pen. We also established anonymity by informing them to exclude their names or initials from any of the forms. On average, the counsellor trainees responded to the items within 10 minutes. We thanked them and promised to share the findings with their department.

Data Analysis

The study employed Microsoft Excel 2006 and Addinsoft XLSTAT 2022.5.2 for a credible analysis of the data set. We used Mean (*M*) with Standard Deviation (*SD*) to ascertain the stress levels among counsellor trainees. Also, the study used an independent samples t-test analysis to evaluate the statistical mean difference in stress based on counsellor trainees' gender, age, and years in training. An independent t-test is a statistical method used in research to compare the means of two independent groups to determine if there is a statistically significant difference between them. The independent samples t-test analysis evaluated whether the difference in the stress levels reported by men and women, those below 35 years and those that were 35 years and above, and, those in year one and those in year two of their studies represent a true or random difference.

Considering the sample size for this study, the total number of items (possible stressors) on the USS, and the extent score of the USS that is predictive of significant psychological distress, the study developed a simple formula ($SS \geq \frac{E}{I} \times Z$) to determine the stressor value that is predictive of significant psychological distress. In the formula, the 'SS' is the predictive value of significant psychological distress of the stressor/item. The 'E' is the extent score of the USS. The 'I' is the total number of items on the USS, and 'Z' is the study sample. From the USS scores of this study and the working formula, the total item/stressor score of the USS ≥ 57 indicated that the item/stressor is predictive of significant psychological distress.

Findings

Table 1, Figure 1, and Table 2 summarize the study results aim, to identify stress levels and evaluate their differences based on counsellor trainees' gender, age, and years in training.

Levels of Stress

The analysis and summary of stress data are in Table 1. Also, the means chart in Figure 1 complements the information in Table 1. As shown in Table 1 and Figure 1, the descriptive analysis of the USS showed that scores of 11% of counsellor trainees fell below the lower quartile, and the data of 21% of them fell below the upper quartile of the dataset. Also, the minimum total score of counsellor trainees was one, the maximum total score was 48, and the median score was 15.

Table 1.

Descriptive Statistics of Masters-level Counsellor Trainees' Stress Levels

Statistic	Stress	Groups	Stress	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Number (n)	92	Gender							
Minimum score	1		Men	16.9	9.6	.7	90	.47	.15
Maximum score	48		Women	15.6	7.2	3			
1st Quartile	11	Age							
Median	15		< 35yrs	15.8	7.9	.2	90	.82	.06
3rd Quartile	21		≥ 35yrs	16.2	8.3	3			
Mean	16.09	Years in training							
Variance (n)	66.06		Year 1	16.0	9.4	.0	42	.95	.01
Variance (n-1)	66.78		Year 2	16.1	6.7	6			
<i>SD</i> (n-1)	8.17								

As shown in Figure 1, 60 counsellor trainees, representing 65% of the sample, obtained scores ≥ 13 . 35% obtained scores ≥ 1 and < 13 . None of the trainees sampled obtained a zero score. Additionally, from the analysis in Table 1, the mean total score obtained was ($M = 16.09$, $SD = 8.17$). Also, the mean total score obtained by male counsellor trainees ($M = 16.9$, $SD = 9.6$) was higher than that of female counsellor trainees ($M = 15.6$, $SD = 7.2$), and the mean total score obtained by counsellor trainees that were 35 years & above ($M = 16.2$, $SD = 8.3$) was higher than that of counsellor trainees that were below 35 years ($M = 15.8$, $SD = 7.9$). Moreover, the mean total score obtained by counsellor trainees in year two ($M = 16.1$, $SD = 6.7$) was higher than that of counsellor trainees who were below 35 years ($M = 16.0$, $SD = 9.4$).

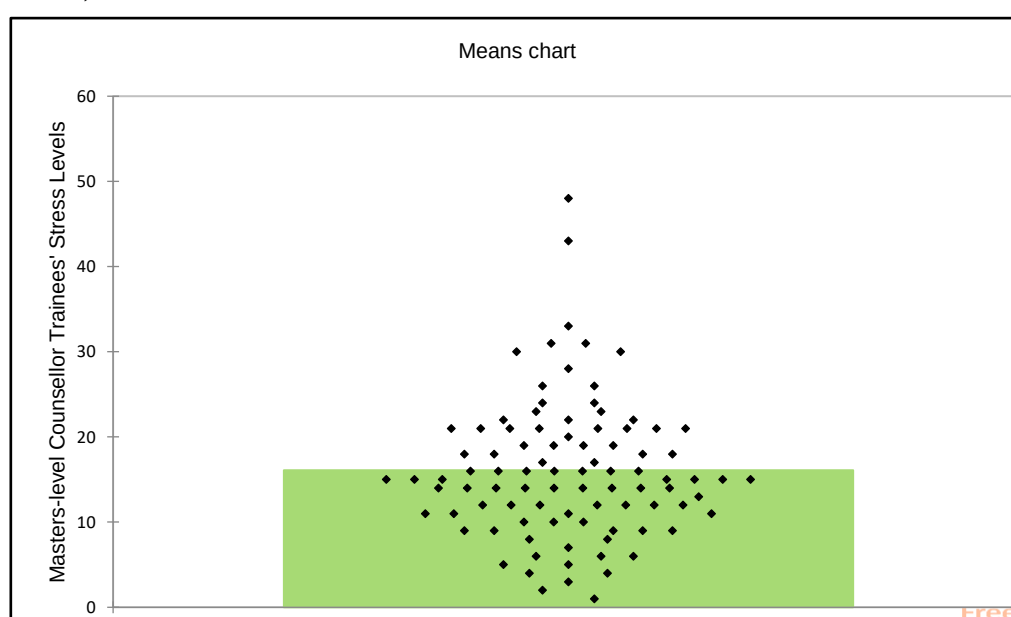


Figure 1. Means Chat of Masters-level Counsellor Trainees' Stress Levels

Predictors of Psychological Distress

In total, 14 stressors were predictive of significant psychological distress to the counsellor trainees because their scores were beyond 57. The stressors were academic/coursework demands, finances and money problems, work, university/college environment, and study/life balance. Other stressors that predicted significant psychological distress to the counsellor trainees were transport, family relationships, parental expectations, procrastination, and housing/accommodation. The rest were parenting issues, child care, friendship, and other demands. The analysis of the items is in Table 2.

Table 2.

The hierarchical order of counsellor trainees' stressors in the University Stress Scale

Stressors	Score	Stressors	Score
Academic/coursework demands	185	Childcare	64
Finances and money problems	119	Friendships	59
Work	110	Other demands	59
University/college environment	100	Romantic relationships	46
Study/life balance	99	Language/cultural issues	39
Transport	90	Relationship break-down	37
Family relationships	85	Physical health problems	28
Parental expectations	83	Discrimination	28
Procrastination	77	Sexual orientation issues	25
Housing/accommodation	70	Mental health problems	13
Parenting issues	64		

Statistical Differences in Stress Levels Based on Demographics

The study predicted a significant difference in stress levels between the demographic groupings of the counsellor trainees. The study considered data on men and women. It also evaluated data on counsellor trainees below 35 years and counsellor trainees 35 years and above. Lastly, it assessed data on counsellor trainees in year one and trainees in year two of their study. The results of the findings are in Table 1.

The independent-sample t-test results in Table 1 indicate no significant difference between men and women counsellor trainees' stress levels [$t_{(90)} = .73, p = .47, d = .15$]. The interpretation of the findings is that men and women counsellor trainees were statistically equal in their stress levels.

Also, concerning age, the results of the findings are in Table 1. As indicated in Table 1, the significance level of the two-tailed t-test was above .05. Thus, we report no statistical difference in the two groups [$t_{(90)} = .23, p = .82, d = .06$]. The interpretation of the findings is that counsellor trainees who were below 35 years old and those who were 35 years and above were statistically equal in their stress levels.

As shown in Table 1, the outcome of the independent sampled t-test employed to compare the differences in the mean levels of stress among counsellor trainees in Year 1 and those in Year 2 indicated that there was no statistical difference in the two groups [$t_{(42)} = .06, p = .95, d = .01$]. It is because the significance level of the two-tailed t-test was above .05. The interpretation of the findings is that counsellor trainees in Year 1 and Year 2 were statistically equal in their stress levels.

Discussion

This study assessed stress levels and associated stressors among masters-level counsellor trainees studying a sandwich mode programme at the University of Education, located in Winneba in Ghana for the 2021/2022 academic year. The study found that counsellor trainees reported stress levels that may cause them substantial psychological distress. The study also identified the perceived stressors behind the distress. Besides, there were no statistical differences in the stress levels of men and women, those below 35 years and those that were 35 years and above, and, those in year one and those in year two of their studies. From the analysis in Table 1 and the mean chart in Figure 1, all the counsellor trainees

sampled reported some stress levels. Moreover, 65% of the counsellor trainees scored and the mean total score of the USS was ≥ 13 . It indicates that the stress levels were predictive of significant psychological distress. Esia-donkoh (2014) implied that sandwich education at the University of Education, Winneba, Ghana, made students report acute, chronic, and episodic stress. Carter (2021) indicated that 82.2% of counsellor trainees sampled in the United Kingdom scored moderate to high range stress levels.

The total mean scores of men and women indicated that counsellor trainees who responded as men reported higher stress levels than their counterparts who were women. This finding contradicts the findings of Baqutayan et al. (2018), who asserted that female postgraduate students reported higher stress than their male counterparts. Baqutayan et al. (2018) indicated that the male postgraduate students reported adequate emotional intelligence levels that assist them in managing their stress. This study could not include emotional intelligence measures, to ascertain their influence on stress levels. However, unlike the findings of Baqutayan et al. (2018), the findings of this study contradict the stereotype assertion that females report higher stress levels than males because they are more emotionally expressive. Also, Adasi et al. (2020) indicated that female undergraduate teacher education students perceived higher overall stress levels than their male counterparts. Aside from notable academic stressors, money problems and living conditions on campus during sandwich mode counsellor training might have contributed to the findings of this study. In a cultural setting, Ghanaian men are the breadwinners of the family. Thus, they are domestically cared for by their female counterparts in the home setting. Finding themselves in a sandwich programme where they virtually have to do all their domestic chores on their own could have had a toll on their mental health. Aside from that, though they are taking care of their financial obligations at the university campus, they may also have to finance the care of their family back home. This double spending might have been a source of distress.

The finding of this study that counsellor trainees who were 35 years and above reported higher stress levels than counsellor trainees who were below 35 years contradicts the findings of Gutierrez et al. (2017). Gutierrez et al. (2017) asserted that graduate-level counsellors with higher age reported lower stress levels than their counterparts with lower age. The finding of this study may be that the younger counsellor trainees coped with the voluminous and intense nature of the sandwich counselling programme better than the older counselling trainees. Often, multitasking work, marriage, extended family and social engagements are burdens of older men in Ghana. Kwaah and Essilfie (2017) asserted that family/marriage problems were a notable stressor among university sandwich students in Ghana. Probably, the findings of this study suggest that both counsellor trainees who were 35 years and above and those below 35 years had challenges with multitasking. However, those 35 years and above were more burdened than those below 35 years.

The difference in mean scores of counsellor trainees in year one and year two indicates that the stress scores of those in year two were slightly higher than the stresses of those in year one. Graduate-level sandwich counsellor trainees in year two of their study battle with academic work on campus, thesis writing, practicum and work concurrently. Thus, it is undoubtedly unsurprising that their stress levels slightly surpass their counterparts in year one. Contrary to the findings of this study, Dessie et al. (2013) and Zegeye et al. (2018) asserted that academic-related stressors affected year one undergraduate students more than their counterparts in other years of their studies.

As indicated in Table 2, 14 stressors predicted significant psychological distress to the counsellor trainees. The top five were academic/coursework demands, finances and money problems, work, university environment, and study/life balance. Kumary and Baker (2008) found that counsellor training is associated with stress levels due to academics, placements, and personal and professional development. From the findings of this study, aside from the limited study period and short revision time for examinations, identifying practicum sites for practical assignments may have contributed to the stress levels reported by the counsellor trainees.

Also, Cieslak (2016) and Zegeye et al. (2018) asserted that academic burden, client population characteristics, working environments and societal pressures trigger high stress and burnout levels among counsellor trainees, affecting their psychological well-being. The finding of this study builds on a fundamental underlying factor that sandwich students, counsellor trainees in general and graduate counsellor trainees have an ascertained history of psychological distress. Thus, Cieslak (2016)

recommended that graduate counsellor trainees recognize and deal with the concurrent graduate education stressors so they might not worsen their stress predicaments.

The revelation that parental expectation was the eighth stressor in the ranking that predicted significant psychological distress to counsellor trainees is surprising. It is surprising because counsellor trainees were adult enough to care for themselves and sometimes their parents. Thus, an expectation is that they should not be concerned about their parents' expectations in academics. However, the extended family systems of bonding in Ghana that allow family members to share in each other's successes and failures might have contributed to the findings of this study. Since parents might be concerned to know and share in the academic success of their adult children, the counsellor trainees may be worried about how their parents may feel if they fail in their academic endeavours.

The final objective of this study was to examine the differences in stress levels among counsellor trainees' gender, age, and years in training. The findings showed an insignificant difference in stress levels regarding gender groups, age groups, and the year in training groups. Knowing that the difference in reported stress levels among male and female counsellor trainees was statistically insignificant is consistent with the findings of Baqutayan et al. (2018), who found that the differences in stress levels for male and female postgraduate students are statistically insignificant. Also, Abasimi et al. (2015) and Atindanbila & BanyenRejoice (2011) found a statistically insignificant difference in stress concerning the gender of university students. However, unlike this study, Abasimi et al. (2015) and Atindanbila & BanyenRejoice (2011) studied undergraduate students at the university. Besides, Adasi et al. (2020) asserted that the difference between male and female university students was statistically insignificant. Thus, the differences in the stress levels between the male university students and that of their female counterparts that Adasi et al. (2020) studied were relatively similar statistically and not noteworthy.

For age groups and stress, knowing that there was statistically no significant difference in stress levels regarding trainees below 35 years and trainees above 35 years contradicts the findings of Myers et al. (2012), who asserted that younger graduate students were significantly more stressed than older graduate students. Also, Gutierrez et al. (2017) found a small, negative correlation between stress and age among masters-level counsellor trainees, indicating that higher age is associated with lower stress levels. Gutierrez et al. (2017) study had a higher sample size from pastoral counselling students. With growth and training in biblical counselling, society anticipates adequate self-care and calmness in managing environmental encounters. However, a study by Saleh et al. (2017) confirmed the findings of this study.

Concerning years in training and stress, the findings that there was a statistically insignificant difference in stress levels regarding Year 1 and Year 2 counsellor trainees are consistent with the findings of Gutierrez et al. (2017), who asserted that masters-level counsellor trainees' stress scores did not have a statistically significant relationship with their hours of completed graduate work. However, Gutierrez et al. (2017) studied stress with emotional intelligence, and empathy. Also, the findings of Ugwoke et al. (2018), who studied a sample of undergraduate students, indicated no significant mean score among student stress levels concerning years in training. The finding of indifference in stress levels of years in training could be that both year one and two counsellor trainees could have been trained in counselling at the undergraduate level. Thus, they could have had some form of knowledge or training in self-care.

Conclusion

This study assessed stress levels among Sandwich Study Master of Education counsellor trainees. The findings revealed that though all the counsellor trainees reported some levels of stress, the scores of 65% of them were predictive of significant psychological distress. Also, 14 stressors were predictive of significant psychological distress among the counsellor trainees. The findings of this research indicate that statistically, stress has no colour irrespective of sandwich study graduate students' age, gender and years in training. Thus, in mitigating implications to engender stress-reducing strategies and techniques, age, gender and years in training should not be discriminated against. The findings complement existing literature and provoke scholarship towards improved counsellor training and counsellor trainees' well-being.

Though studies report higher stress levels among graduate trainees, such stress levels should not inhibit lifelong learning and academic achievements. Thus, counsellor educators and supervisors should assist

sandwich study masters-level counsellor trainees in developing stress-reducing and positive coping strategies while on campus. The assistance should also include a practice model to guide and motivate counsellor trainees to adhere to positive coping strategies. Since counsellor educators would create an enabling study environment for counsellor trainees and assist them in reducing and coping with their stress levels, it is eminent that the onus lies on the counsellor trainees themselves to manage their stress levels to improve their mental health. Thus, counsellor trainees must consider practising self-awareness, self-assessment, and self-assistive strategies to identify and cope with their stressors. Also, counsellor trainees should quickly seek psychological help from counsellor educators, colleague counsellor trainees, the university counselling centre, face-to-face counsellors and online counselling sites.

Academic/coursework demands emerged as the number one stressor that is predictive of significant psychological distress among the counsellor trainees. Thus, there is a need for counsellor educators and other stakeholders to consider a Sandwich Hybrid and Blended Learning environment for sandwich counsellor training to ease academic pressure on campus. Counselling is a specialised programme rooted in psychology. The assumption is that the admission requirement for a Master of Education (MEd) in counselling could be an undergraduate counselling degree. However, at the University of Education in Winneba, the specific requirements for a sandwich counselling MEd is an undergraduate degree with a GPA of not below 2.5 from a Ghana Tertiary Education Commission accredited or assessed university locally or internationally, in Counselling Psychology or a related field of study (E.g., Psychology, Guidance & Counselling, Social Work, and Nursing). Also, applicants whose GPA is below 2.5 could be considered subject to the current population they serve and contingent upon passing a written and oral examination (UEW, 2023).

The requirement allows relatively low GPAs to get admission into the programme. Such applicants might also not have a specialised component of fundamental counselling knowledge. The intensive nature of the programme could make those counsellor trainees lag in academics, which may be a source of stress for them. Thus, it could be appropriate for the University to tailor its sandwich master's counselling degree programme towards only applicants with a degree with a specialised component of adequate fundamental counselling knowledge. Also, counsellor educators must consider introducing a full-time regular programme in Master of Education (Med) or Master of Arts (MA) in counselling. Counsellor educators could structure the regular-based master's programme in counselling to consider applicants who do not have a degree with a specialized component of adequate fundamental counselling knowledge since there is time in regular-based programme durations to study the fundamentals of the courses of an academic programme.

Considering a standard practice, the findings of this study must not be generalized to the entire masters-level counsellor trainees at the University of Education, Winneba, Ghana, because masters-level counsellor trainees that are studying as regular students would have characteristics that could be diverse from masters-level counsellor trainees that are studying as sandwich students. However, inferences from this study could suit similar studies to indicate how common the phenomenon is. Also, the study used a self-reported scale, the USS that could result in social desirability bias. Thus, respondents could have under-reported their responses to the study instrument. Finally, though the 60% survey response rate in this study is acceptable, a higher response rate of 80% and above could have improved the findings of the study.

Stress seems to be a topical domain in the mental health phenomena. Findings and recommendations on its studies provide a pivotal remedy in tackling mental health issues within the educational arena. Thus, future studies should expand the objective and methodology of this study to consider using a mixed method approach to ascertain an in-depth understanding of stress among sandwich mode of study masters-level counsellor trainees. Also, study populations from different counsellor training institutions could broaden the findings of stress levels among counsellor trainees.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Child Self-Regulation and Behavior Questionnaire and Assessment of Executive Functions Scale: Adaptation Study for 4–6-Year-Old Children*

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Abstract

This research aimed to adapt two measurement tools assessing self-regulation and executive function skills in children aged 4–6 years into the Turkish language. The first scale, "Child Self-Regulation and Behavior Questionnaire" (CSBQ) developed by Howard and Melhuish (2017), assesses children's self-regulation and social development skills based on teachers' opinions. The second scale is the "Assessment of Sensory Processing and Executive Functions in Childhood" (EPYFEI) (Romero-Ayuso et al., 2018). This scale aims to determine the sensory processing and executive function skills of children between the ages of 3 and 11 based on parental opinions. A total of 454 children aged 4-6 attending preschool and kindergarten education in a province in southwestern Türkiye participated in the study. An exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to evaluate the construct validity of the CSBQ and EPYFEI scales. EFA results of the CSBQ yielded three subscales: cognitive self-regulation, behavioral and emotional self-regulation, and sociability. CFA results showed adequate fit indices for the CSBQ's 15-item, three-factor structure. Additionally, the analysis for concurrent validity revealed a positive and significant relationship between the scale and the Child Behavior Rating Scale. The internal consistency coefficient for the total scale was .84, and for the subscales, it ranged from .74 to .80. Regarding EPYFEI, the item total correlations of the sensory processing subscale were below .30, and the item variance was below .50. This yielded the removal of the "sensory processing" subscale, and hence the scale was adapted into Turkish as "Assessment of Executive Functions in Childhood" (AEFC). EFA results for the AEFC revealed three factors (executive attention and working memory, emotional and behavioral self-regulation, and inhibitory control). The results of the CFA indicated that the scale's fit indices, consisting of 14 items and three factors, were sufficient. The internal consistency coefficient for the entire AEFC scale was .83, with the subscales ranging from .72 to .84. These findings demonstrated that children's self-regulation skills and social development utilizing CSBQ and executive function skills using the AEFC can be measured validly and reliably.

Keywords: Self-regulation, social development, executive function skill

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Introduction

The emphasis on fostering self-regulation (SR) skills in early childhood is growing steadily. This growing importance is reflected in the increasing advocacy for incorporating SR into early childhood education curricula and programs (Lenes, 2020; Vasseleu, 2022) and studies to develop educational programs to support these skills (Howard, Vasseleu, Batterham, & Neilsen-Hewett, 2020; Tominey & McClelland, 2011). SR skills affect children's approaches to learning. For this reason, supporting these skills in preschool is a building block for achieving more significant gains in education (Bryce, Whitebread, & Szucs, 2015). Self-regulation development, which begins with life, is an integral part of learning and is essential for cognitive, social, and emotional development. This developmental process is shaped by biological and environmental factors that begin to show their effects even before birth (Bronson, 2000). With the influence of these factors, there is an increase in SR skills, especially between the ages of 3 and 7 (Montroy, Bowles, Skibbe, McClelland, & Morrison, 2016). Recent advancements in neuroscience indicate that prioritizing SR in education can enhance children's engagement in learning and establish positive academic pathways, thereby improving school readiness (Blair & Raver, 2014).

Literature Review

Definitions of Self-Regulation

Self-regulation is defined in different ways in literature. According to Bandura (1982), SR is about controlling behaviors and emotions. For Zimmerman (2002), SR is an individual's ability to organize knowledge, actions, and emotions to achieve a goal. Another definition focuses on the 'self,' emphasizing that individuals can control behaviors, emotions, and thoughts. In this sense, SR means the regulation of processes by the self (Baumeister, Schmeichel, & Vohs, 2007). A hierarchical integrated model of SR sheds light on its developmental processes, in which its cognitive, emotional, behavioral, physiological, and genetic levels are mutually influential and bidirectionally and iteratively related (Blair & Ku, 2022).

SR encompasses cognitive, emotional, and behavioral dimensions (Bronson, 2000). EF skills are an aspect of cognitive self-regulation (Roebers, 2017). EF is about organizing the mental processes necessary to exhibit behavior toward complex goals. These high-level SR mechanisms encompass inhibitory control, cognitive flexibility, and working memory processes and play a crucial role in facilitating planning and goal-directed behaviors essential for navigating daily life (Diamond, 2013). EF consists of complex tasks, such as the ability to focus and maintain attention, consider different options, prepare a plan, maintain progress, change behavior to achieve a desired goal, and shift attention as necessary to meet other demands (Buckner, Mezzacappa, & Beardslee, 2009). Attention involves the conscious mental effort through which individuals receive information. It engages all senses, with the attention span varying based on the length, significance, and complexity of the stimulus being processed (Matthews, Ponitz, & Morrison, 2009). Attention is important for understanding classroom rules and social expectations (McClelland & Cameron, 2012). Working memory is the cognitive system responsible for storing and processing new and previously acquired information, enabling individuals to engage more dynamically in tasks. Recalling game rules, taking turns, and participating in group creative activities exemplify working memory in action (McClelland & Cameron, 2012). Inhibitory control acts as an internal force that counteracts impulses, allowing individuals to regulate their behavior, such as raising a hand rather than shouting the answer. It is a learned behavior that involves controlling or inhibiting one's thoughts and feelings. Inhibitory control allows children to adjust or avoid giving the wrong answer (Ponitz, McClelland, Matthews, & Morrison, 2009). The use of EF translates into goal-directed behavior and successful social and academic outcomes (Calkins & Dedmon, 2000; Leerkes, 2000; Paradise, O'Brien, Calkins, & Lange, 2008). Success in school is closely linked to SR skills, encompassing the ability to maintain focus and attention, manage emotions and stress responses, engage in reflective thinking, and foster positive social interactions with teachers and peers (Blair & Raver, 2015). Children utilize cognitive, behavioral, and emotional skills to pay attention to, remember, and respond appropriately to teacher instructions (Raver et al., 2012).

The emotional aspect of SR pertains to one's ability to manage emotions, which enables individuals to express their feelings appropriately and effectively communicate with others. Regulating emotions properly is essential for children's social growth since emotion regulation forms the foundation for children's comprehension and interpretation of social interactions and their reactions in social settings, influencing how others perceive and respond to them (Blair et al., 2014).

As being another dimension of SR, behavioral regulation includes, includes focusing on the task, paying attention, complying with instructions, and preventing unwanted actions (Morrison, Ponitz, & McClelland, 2010). These skills are critical in early education, as they lay the foundation for success in both academic and social life (McClelland et al., 2007). Children must effectively direct their attention to specific tasks, manage their behavior, and process and integrate information in school. (Ponitz et al., 2009). Research indicates a correlation between academic achievement, executive functions, and overall school success with behavioral regulation skills (McClelland et al., 2007). Moreover, early mathematics and literacy skills positively correlate with behavioral SR skills assessed directly and by the teacher (Schmitt, Pratt, & McClelland, 2014).

The development of SR skills is closely intertwined with the growth of skills in other domains, including motor, language, cognitive, and social (Kopp, 1989). It is suggested that children with high levels of social-emotional skills and cognitive control are better at participating in academic tasks, following teachers' instructions, making plans, exchanging information with their peers, and modeling appropriate peer behavior (Denham et al., 2013). Children who can regulate their behavior can meet classroom expectations and who do not give up in the face of failure in learning tasks have higher success in school (McClelland, Acock, & Morrison, 2006). For children, who cannot regulate their behavior appropriately, attention problems, weaken their effective learning and decrease their success levels by engaging in off-task behavior (Hughes & Kwok, 2006).

Assessment of Children's Self-Regulation Skills

Children's SR skills are commonly assessed based on the performance and opinions of adults (parents or teachers). In addition, there are also teacher observations of children's performance (Howard et al., 2019; Schmitt et al., 2014). Performance-based measurement tools evaluate children's performance instantaneously and objectively (Howard et al. 2019). Some of these assessment tools include only one aspect of self-regulation skills, such as working memory or inhibitory control (Gerstadt, Hong, & Diamond, 1994; Mischel et al., 1989). For example, the "Day-Night Task" (Gerstadt, Hong, & Diamond, 1994) and Simon Says (Strommen, 1973) scales measure inhibitory control skills, while Memory Battery for Preschool Children (Obalı, 2018) measures working memory auditorily. Others evaluate all dimensions: inhibitory control, working memory, and attention flexibility. The Head-Toes-Knees-Shoulders (HTKS) test (McClelland et al., 2014), which was developed to evaluate the cognitive flexibility, inhibitory control, and working memory skills of preschool children (Ponitz, McClelland, Matthews, & Morrison, 2009; Gonzales et al., 2021), is widely used in studies in the literature (Becker, Miao, Duncan, & McClelland, 2014; İvrendi, 2011; Sezgin & Demiriz, 2015).

In the domestic literature, there are measurement tools adapted to Turkish (Batum & Yağmurlu, 2007; Çiftçi, Uyanık, & Acar, 2020; Ecirli & Ogelman, 2015; Fındık Tanrıbuyurdu & Güler Yıldız, 2014; Sezgin & Demiriz, 2016) or developed (Bayındır & Ural, 2016; İvrendi & Erol, 2018; Yılmaz & Zembat, 2021) to determine children's SR skills based on adult opinions. For example, Çiftçi, Uyanık, and Acar (2020) adapted the Childhood Executive Functions Inventory (Thorell & Nyberg, 2008) scale into Turkish. This scale consists of two factors (Working Memory and Inhibitory Control) and 24 items. The results showed that this scale can be used to evaluate the executive functions of 4–6-year-old children validly and reliably. As an example of scale development studies, İvrendi and Erol (2018) developed the "Self-Regulation Skills Scale for 4–6-Year-Old Children-Teacher Form". This scale has three factors, "attention, working memory, and inhibitory control," and includes 22 items. Their results indicated that children's SR skills can be validly and reliably measured by using this instrument (İvrendi & Erol, 2018, p. 184). Although there has been an increase in scales developed and adapted for children's SR skills in Türkiye, they still appear to be limited in number.

The scales based on adult opinions can produce comprehensive data with minimum time and cost (Howard et al., 2019). Evidence showed that measurement tools based on teacher opinions were more effective in predicting children's skills than task-based assessment (Duncan, McClelland, & Acock, 2013; Suchodoletz et al., 2013). For example, when the predictive levels of teacher-rated, observed, and directly evaluated behavioral SR skills for academic success in preschool children were investigated, teacher evaluations were found to be the strongest predictor of children's literacy skills (Schmitt et al., 2014). It is also important to note that parent and teacher evaluations might be sensitive to biases and more process-oriented (Howard & Melhuish, 2017). For example, teachers and parents may interpret the same behavior differently, as their evaluations can be influenced by their distinct daily interactions and experiences with the child. This variance in interpretation can also extend to how they assess items on the same scale (McClelland, Ponitz, Messersmith, & Tominey, 2010). On the other hand, different sources of information, such as parents or teachers, allow data about the child's SR to be collected from large samples in a relatively short time. Considering the positive and negative aspects of scales to evaluate children's SR skills, it is stated that data obtained from multiple information sources and the use of more than one stakeholder in the data collection process is a valuable strategy when making decisions about these skills (Nelson, Robinson, & Hart, 2005; Smith-Donald, Raver, Hayes, & Richardson, 2007).

There is increasing evidence that SR skills are critical to children's lifelong success, including academic and social skills (Amani, Koruzhdeh, & Taiyari, 2019; Finders, McClelland, Geldhof, Rothwell, & Hatfield, 2021; Lipsey et al., 2017). Research findings have proved SR skills' relationship with several areas of development, such as school achievement (math and reading achievement), false-belief understanding (FBU) and social competence. (McClelland, Acock, Piccinin, Rhea, & Stallings, 2013; Razza & Blair, 2009). Moving from the importance of SR skills in children's lives, it seems necessary to enrich measurement tools to obtain information about such skills from multiple sources, such as parents and teachers. Toward this end, this study aimed to adapt two scales into Turkish. The first one is the "Child Self-Regulation and Behavior Questionnaire" (CSBQ) scale developed by Howard and Melhuish (2017) to evaluate children's SR and social skills. The second one is the "Assessment of Sensory Processing and Executive Functions in Childhood" (EPYFEI) scale developed by Romero-Ayuso et al. (2018) to determine children's executive function skills based on parental opinions. Adapting these two scales to Turkish diversifies the self-regulation measurement tools available in the literature from different aspects. First, these scales are short and quickly applicable, and thus, they are convenient in terms of time and effort for teachers and parents. Second, these scales allow obtaining data about children's SR skills from both teachers and parents, yielding information from multiple sources. Third, CSBQ includes all SR dimensions and can provide a holistic view of children's SR skills.

Method

In this scale adaptation study, CSBQ and EPYFEI were adapted to Turkish. The scale adaptation process was carried out in accordance with the steps defined by Karagöz and Bardakçı (2020). These steps are as follows: adaptation translation of the original scale into Turkish, comparison of the translations, back translation of the scale, determination of the draft form of the translated scale, examination of language equivalence, conducting reliability and validity analyses, and finally, presentation of the final scale.

Participants

In the first half of the 2021-2022 academic year, 454 children aged 4-6 attending preschool schools affiliated with the Ministry of National Education in a province in the southwestern part of Türkiye participated in the research. The study utilized an easily accessible sampling method, including teachers and parents who volunteered to participate.

Before initiating the research, ethical approval and permission to conduct this study were secured from the Provincial Directorate of National Education. The administrators of the schools were informed about the research. Afterward, information about the study was shared with the teachers at the school. Teachers and parents who wished to participate in the study were requested to fill out the scales.

Teachers were asked to complete scales for 10 typically developing children (5 girls, 5 boys) in their classrooms, a process designed to ensure a diverse and representative sample.

Among the children participating in the study, 47.4% (n=215) were girls, while 52.6% (n=239) were boys. Regarding age distribution, 32.2% (n=146) of the children were aged 48-60 months, and 67.8% (n=308) were aged 60-72 months. Regarding preschool attendance, 66.1% (n = 300) of the children had attended for one year, 13.4% (n = 61) for two years, and 20.5% (n = 93) for three years.

The mean age of the mothers participating in the study was calculated. 18% (n=82) of the mothers were between 20-30 years of age, 60.6% (n=275) were between 31-40 years of age, and 21% (n=97) were over 40 years of age. The mean age of the fathers was as follows: 7.7% (n=35) were between 20-30 years of age, 55.9% (n=254) were between 31-40 years of age, and 36.3% (n=165) were 40 years of age or older. Among the mothers participating in the study, 9.9% (n=45) were primary school graduates, while 61.5% (n=279) held university degrees. Similarly, among the fathers, 17% (n=77) were primary school graduates, and 54.4% (n=247) were university graduates.

Data Collection Tools

Personal Information Form

The researchers created this form to obtain information about the socio-demographic features of children and parents. The parents filled in this form, which included items related to the child's gender, age, years of attending preschool education, the parents' age and education level, and monthly income.

Child Self-Regulation and Behavior Questionnaire (CSBQ)

Within the scope of this research, "Child Self-Regulation and Behavior Questionnaire" (CSBQ) developed by Howard and Melhuish (2017) to evaluate the self-regulation and social development skills of 3–6-year-old children, was adapted into Turkish for 4–6-year-old children. Three-year-old children were not included in this study because the low rate of three-year-olds attending preschool in Türkiye makes it challenging to reach this age group. As seen in the Ministry of Education 2021/22 academic year's Statistical Regional Units Classification, the schooling rate is 11.45% for the 3-year-old group and 56.77% for the 4-5 age group (MEB Statistics, 2022). Teachers fill out CSBQ for children. This scale has 34 items, a four-factor structure, and a 5-point Likert-type feature (1 = Never, 5 = Always). The cognitive self-regulation subscale (Cronbach's Alpha = .87) includes behaviors related to control over thinking and attention (e.g., persists in difficult tasks, chooses activities on one's own). The emotional self-regulation subscale (Cronbach's Alpha = .83) consists of behaviors related to control over emotional reactions (e.g., getting over sadness quickly and not easily upset by minor events). The behavioral self-regulation subscale (Cronbach's Alpha = .89) has items related to control over impulsive behaviors (e.g., waiting for one's turn, sitting still). The sociability subscale (Cronbach's Alpha = .74) includes behaviors related to the ease and quality of social interactions (e.g., plays easily with other children) (Howard & Melhuish, 2017).

Child Behavior Rating Scale (CBRS)

This study examined the concurrent validity of the CSBQ scale using the CBRS, which teachers completed for children. The CBRS, adapted into Turkish by Sezgin and Demiriz (2016), consists of two factors and 17 items: Behavior regulation and social skills. The behavior regulation subscale includes 10 items about working memory, inhibitory, and attention control skills. There are 7 items in the social skills subscale, which encompasses children's social skills, such as following instructions, cooperating, waiting their turn, and using verbal or physical violence against other children. The Cronbach Alpha reliability coefficient of the CBRS subscales was between .84 and .96. The test-retest reliability of the scale was found to be 0.75 (Sezgin & Demiriz, 2016). In this current study, the internal consistency coefficient of CBRS was calculated (Cronbach's Alpha = .88).

Assessment of Sensory Processing and Executive Functions in Childhood" (EPYFEI)

"Assessment of Sensory Processing and Executive Functions in Childhood" (EPYFEI) scale developed by Romero-Ayuso et al. (2018) to evaluate the sensory processing and executive functions of children aged 3–11 years was adapted into Turkish for children aged 4-6. As explained below, the results of

this study's analyses led to the renaming of the scale as Assessment of Executive Functions. The scale, which was filled out by parents considering the child, had a five-factor structure: (1) executive attention, working memory, and initiation of actions; (2) general sensory processing; (3) emotional and behavioral self-regulation; (4) control, correction of actions, and problem-solving; and (5) inhibitory control. It comprises 34 items with a 5-point Likert feature (1 = Never, 5 = Always). Cronbach's Alpha values range between 0.74 and 0.94.

Data Collection Process

Adaptation Process of Scales into Turkish

This study aimed to adapt two scales into Turkish: CSBQ and EPYFEI. The scale adaptation process consisted of the translation of the original scale into Turkish, comparison of the translations, back translation of the scale, determination of the draft form of the translated scale, examination of language equivalence, conducting reliability and validity analyses (Karagöz & Bardakçı, 2020). In the translation stage, the Forward-Backward Translation Method was used. This method requires a single translator or a group of translators to translate the test from the source to the target language. Then, another group of translators evaluates the equivalence of the two test versions (Hambleton et al., 2005). These experts could be linguists, researchers, or academicians who are experts in the field measured by the scale and know both languages well (Karagöz & Bardakçı, 2020). In this study, the scale was translated into Turkish by a linguist, then translated from its Turkish form back into its original language, and the consistency of the scale items in both forms was tested to create the most appropriate Turkish version. Following this, opinions were obtained regarding content and language consistency from four faculty members who work in the field of preschool education and are fluent in both languages, as well as a preschool teacher with a master's degree. The experts examined whether the scale items reflected their original language counterparts and content validity. The suggested corrections were made in line with the experts' opinions, and the ready-to-implement form of the scale items was obtained. In the next stage, the scale form was filled out by four preschool teachers working to test the comprehensibility of the items.

Finally, the Turkish and English forms of the scales were filled out for 30 children one week apart by teachers whose native language is Turkish and who have a good command of English. According to Karagöz and Bardakçı (2020), to state that the Turkish scale is linguistically equivalent to the original scale, there must be a positive and high-level relationship between the calculated total scores of the two scales. If the Pearson correlation coefficient is between .70 and 1.00, the language equivalence of the scale is high (Karagöz & Bardakçı, 2020). Hence, the Pearson Product Moment Correlation Coefficient between the total scores obtained from the Turkish and English forms of the scales was calculated. The results were as follows: .96 for the CSBQ scale and .95 for the EPYFEI scale. Based on these values, it can be concluded that the scale had language validity. After these procedures, the final version of the scale, ready for application, was obtained, and the scales were filled out for 454 children aged 4-6 who were attending preschool education.

In the second stage, the surface and content validity were examined. Using Lawshe (1975), one of the analysis methods, experts evaluated each item of the scale by classifying it as "not suitable, partially suitable, or appropriate" and stating their suggestions for possible corrections. Similar ratings are available in the literature (Erol & İvrendi, 2018). The final iteration of the scale was crafted by reviewing expert feedback and making appropriate adjustments to the items within the predetermined framework.

In the next phase of the validity study, the scales' construct validity was examined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Additionally, the Child Behavior Rating Scale was used to assess concurrent validity only for the CSBQ. It is suggested that the number of participants for EFA should be at least 300 and between 5 and 10 people per item (Tabachnick & Fidell, 2015). The number of participants in this study (n=454) meets this suggestion. In determining the items to be included in the scale, attention was paid to ensure that the item factor loadings were at least .30 (Tabachnick & Fidell, 2015), the eigenvalue for the factors was greater than 1, and the items loaded on each factor were consistent in terms of meaning and content (Büyüköztürk, 2012). In EFA, the Principal Component Analysis and Varimax orthogonal rotation method were

chosen, which reduces the number of variables and allows for collecting the most information with the fewest items (Erkuş, 2016). There is a similar use of the Varimax orthogonal rotation method in scale development studies (Atan & Buluş, 2021; Kurnaz, 2019). There are seven-factor extraction methods in exploratory factor analysis. When factor extraction methods were compared, it was stated that principal component analysis was the method that explained the variance in the structure to be measured the most under all conditions (Karaman, Atar, & Aktan, 2017) and is the most frequently used method (Büyüköztürk, 2002; Henson & Roberts, 2006; Velicer & Jackson, 1990).

In the CFA, χ^2/sd , RMSA, AGFI, GFI, CFI, NNFI, IFI, PNFI, PGFI, NNFI, and SRMR values were examined. The value ranges given by Çokluk, Şekercioğlu, and Büyüköztürk (2015) regarding the fit indexes were considered when evaluating CFA results.

The third stage of the adaptation process consisted of reliability analysis. The reliability of both scales was evaluated by calculating the internal consistency coefficients using Cronbach's Alpha. A scale with .80 and above Cronbach's Alpha (α) coefficient is highly reliable (Kalaycı, 2009). Therefore, an α value above .80 was considered as a criterion in this study. The research data were analyzed using SPSS 22 and AMOS 20 programs.

Findings

Results related to the Content and Face Validity of CSBQ and EPYFEI

Based on the experts' opinions on each item, the content validity index (CVI) was calculated, and the results are given in Table 1.

Table 1.

Results regarding the Content Validity Index of CSBQ and EPYFEI

Item Numbers	CSBQ				EPYFEI			
	U	KU	UD	KGO	U	KU	UD	KGO
Item 1	5	0	0	1.00	5	0	0	1.00
Item 2	5	0	0	1.00	5	0	0	1.00
Item 3	5	0	0	1.00	5	0	0	1.00
....								
Item 10	5	0	0	1.00	4	1	0	0.60
....								
Item 15	4	1	0	0.60	5	0		1.00
....								
Item 34	5	0	0	1.00	5	0	0	1.00

*U = Suitable, KU = Partially Appropriate, UD = Not Applicable, KGO = Scope Validity Rate

According to Table 1, 5 experts evaluated items of the CSBQ and EPYFEI was determined to be .98 for both scales. The experts' evaluation of face validity stated that the items measure the relevant structure.

Results Regarding the Validity of the Child Self-Regulation and Behavior Questionnaire (CSBQ)

Exploratory Factor Analysis (EFA) of CSBQ

EFA was conducted to determine the construct validity of the CSBQ. While selecting the number of factors, many values were taken into consideration, aiming to reach the most information with the least number of items (Büyüköztürk, 2002). In terms of KMO, it has been stated that 50 and above is an acceptable value (Çolakoğlu & Büyükeksi, 2014). In this regard, the number of items was reduced using the Varimax orthogonal rotation method through Principal Component Analysis to retain the most informative items while minimizing redundancy. Twelve items were eliminated from the measurement tool due to low item-total correlation values ($<.30$), item variance ($<.50$), and overlapping features. The remaining items exhibited a Kaiser-Mayer-Olkin (KMO) value of .86 and a Bartlett Sphericity Test value of .000 ($p < .05$), indicating the suitability of the data for factor analysis (Kalaycı, 2016). In the Common Variance Table, which elucidates how much variance each item explains, lower values (e.g., below .30) suggest poor fit with other items. An item-test correlation value above .30 indicates a sufficient relationship between the item and the structure to be measured

(Tabachnick & Fidell, 2015). The common variance values of the scale items ranged from .43 to .71. Factor determination relied on factors with eigenvalues exceeding 1, and the scatter plot is depicted in Figure 1.

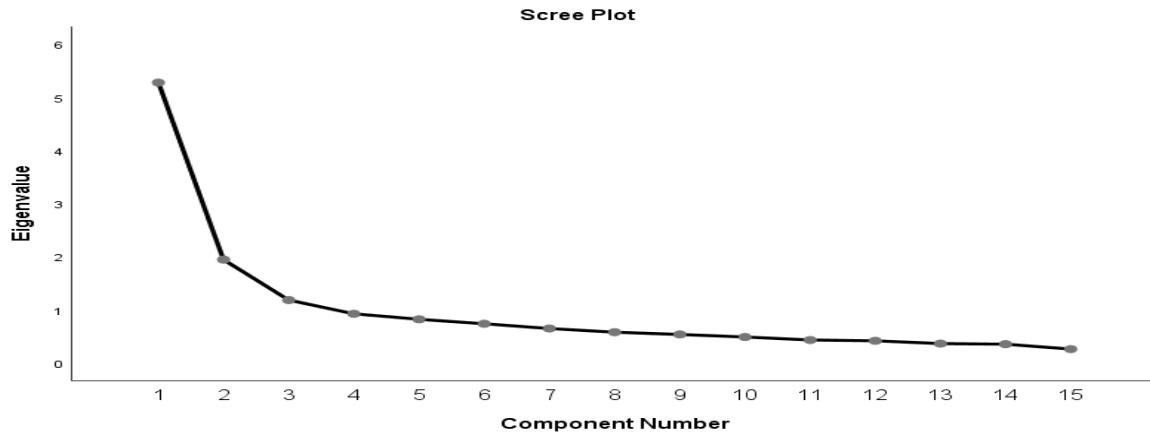


Figure 1. CSBQ factor analysis line chart

According to Figure 1, the scale appears to have a three-factor structure as it is not separated by an obvious line after the third point. Results related to these components are presented in Table 2.

Table 2.

Number of Factors Based on Eigen Value Statistics and Explained Variance Ratio

Subscales	Initial Eigenvalues			Eigen Sums of Square Loadings		
	Sum	Variance%	Totaled%	Sum	Variance%	Totaled%
Cognitive self-regulation	5.277	35.181	35.181	2.960	19.730	19.730
Behavioral and emotional self-regulation	1.946	12.975	48.156	2.886	19.240	38.970
Sociability	1.186	7.909	56.065	2.564	17.095	56.065

Upon examination of Table 2, three factors with eigenvalues exceeding 1 and their respective variance ratios are delineated. The cognitive self-regulation factor elucidated 35.181% of the total variance, the behavioral and emotional self-regulation factor expounded 12.975% of the total variance, and the sociality factor accounted for 7.909% of the total variance. Subsequently, the rotation process was executed to attain meaningful factors and ascertain the inclusion of items within each factor, as depicted in Table 3.

Table 3.

Factor Loadings of the Items in the Rotated Principal Component Analysis Method of the CSBQ Scale

Child Self-Regulation and Behavior Questionnaire			Factors		
			1	2	3
Cognitive self-regulation	I1	Persists with difficult tasks. .	.746	.358	.160
	I2	Does not need much help with tasks. .	.704	.081	.013
	I3	Persists with tasks until completed.	.700	.302	.253
	I4	Chooses activities on their own.	.670	.146	-.043
	I5	Likes to work things out for self.	.624	.215	.143
Behavioral and emotional self-regulation	I6	Is impulsive, acts without thinking.	.162	.096	.795
	I7	Restless, does not keep still for long.	.200	-.177	.723
	I8	Shows wide mood swings.	-.003	.160	.722
	I9	Often loses temper, has tantrums.	-.003	.223	.712
Sociability	I10	Will play easily with new children.	.152	.776	-.032
	I11	Has regular friends.	.093	.655	-.032
	I12	Liked by other children.	.376	.653	.185
	I13	Gets on well with other children.	.215	.620	.381
	I14	Offers to help others.	.407	.575	.126
	I15	Shares sweets or toys with other children.	.358	.551	.265

According to Table 3, the load values were between .74 and .62 for the cognitive self-regulation subscale (5 items), .79 and .71 for the behavioral and emotional self-regulation subscale (4 items), and .55 to .77 for the sociability subscale (6 items). The factor loading values varied between .55 and .77.

Confirmatory Factor Analysis of CSBQ

CFA was implemented to evaluate the model derived from EFA. The data collected from 282 children not included in EFA was used for CFA, and goodness of fit values were examined. The value ranges given by Çokluk, Şekercioğlu, and Büyüköztürk (2015) regarding the fit indexes were considered when evaluating CFA results (Table 4).

Table 4.

Findings regarding the fit index

Fit Indexes	Perfect Fit Criterion	Good Fit Criterion	Value	Fit Level
χ^2/sd	$0 \leq \chi^2/sd \leq 2$	$2 \leq \chi^2/sd \leq 3$	2.974	good fit
RMSEA	$.00 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$	.08	good fit
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI \leq .90$	.85	good fit
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI \leq .95$	.90	good fit
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$	.90	good fit
IFI	$.95 \leq IFI \leq 1.00$	$.90 \leq IFI \leq .95$	.90	good fit
PNFI	$.95 \leq PNFI \leq 1.00$	$.50 \leq PNFI \leq .95$	.69	good fit
PGFI	$.95 \leq PGFI \leq 1.00$	$.50 \leq PGFI \leq .95$	.63	good fit
NNFI	$.95 \leq NNFI \leq 1.00$	$.90 \leq NNFI \leq .95$	.90	good fit
SRMR	$.00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$	.07	good fit

The fit indices, $\chi^2/sd= 2.974$, $RMSEA=.08$, $AGFI=.85$, $GFI=.90$, $CFI=.90$, $IFI=.90$, $PNFI=.69$, $PGFI=.63$, $NNFI=.90$, and $SRMR=.07$ values show a good fit criterion. Based on these values, it can be stated that CFA results confirm the scale structure with a 15-item- three-factor structure.

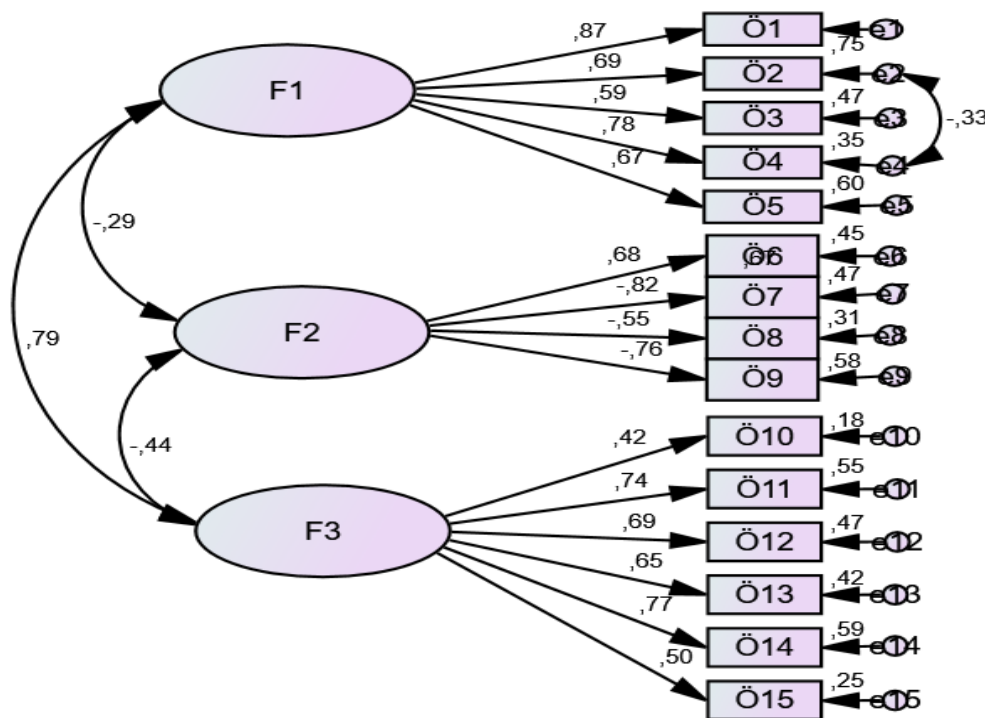


Figure 2. Path diagram obtained by confirmatory factor analysis

Note: Factor 1=Executive attention, Working memory, Factor 2=Emotional and behavioral self-regulation, Factor=3 Inhibitory control.

The CFA results in Figure 2 demonstrated that factor validity verified the scale with 15-item- 3 subscale structure of the CSBQ scale. Findings regarding the concurrent validity of the CSBQ are presented in Table 5.

Table 5.

Correlation Analysis Results for the Child Behavior Rating Scale and the CSBQ (N=454): Concurrent Validity

Subscales	CBRS Behavior	CBRS Social Skills	CBRS Total	Cognitive Self-regulation	Behavioral and emotional self regulation	Sociability	CSBQ Total
CBRS-Behavior	1						
CBRS-Social Skills	.717**	1					
CBRS- Total	.958**	.888**	1				
Cognitive Self-regulation	.715**	.553**	.701**	1			
Behavioral and emotional self regulation	.382**	.585**	.495**	.285**	1		
Sociability	.570**	.558**	.608**	.610**	.308**	1	
CSBQ Total	.718**	.728**	.775**	.817**	.675**	.833**	1

** $p < .01$

According to Table 5, the highest correlation between the CSBQ and CBRS was between the behavior subscale of the CBRS and the cognitive self-regulation subscale of the CSBQ ($r = .71$, $p < 0.01$). A high positive correlation was found between the total scores of the CBRS and CSBQ ($r = .77$, $p < .01$).

Reliability Results of CSBQ

Cronbach's Alpha value was used to examine the scale's internal consistency coefficient, which is presented in Table 6.

Table 6.

Measurement Tool Statistics and Internal Consistency Coefficients

Subscales	Average	Variance	Standard deviation	Number of Items	Internal Consistency (Cronbach Alpha) Coefficient
Cognitive self-regulation	19.2599	12.533	3.54016	5	.78
Behavioral and emotional self-regulation	16.3436	11.961	3.45849	4	.74
Sociability	24.1696	13.527	3.67797	6	.80
CSBQ Total	59.7731	68.723	8.28995	15	.84

Table 6 indicates that the CSBQ scale's internal consistency coefficient is .84, and its subscale coefficients are between .74 and .80.

Results Regarding the Validity of the "Assessment of Sensory Processing and Executive Functions in Childhood"(EPYFEI) Scale

Exploratory Factor Analysis (EFA) of EPYFEI:

EFA was implemented to investigate the construct validity of the EPYFEI. In determining the appropriateness of the data for factor analysis, a KMO value of .50 and above is acceptable (Çolakoğlu & Büyükekşi, 2014). The Varimax orthogonal rotation method was applied using Principal Component Analysis. Twenty items with item-total correlation values below .30, item variance below .50, and overlapping features were removed from the measurement tool. Sample items related to the "sensory processing" subscale, which is included in the original name "Assessment of Sensory Processing and Executive Functions in Childhood"(EPYFEI) of the scale developed by Romero-Ayuso et al., (2018), are as follows: "Has problems in visually recognizing objects. Touches or rubs the body part touched by someone. He usually leans on himself or an object or wall to support his head and body. Has problems climbing stairs, moving around, stumbling, or having difficulty going down a slide in the park or elsewhere." It contains a total of 7 items. Since the item total correlation values of the sensory processing subscale were below .30 and the item variance was below .50, this dimension was removed from the scale. The author who developed the scale was contacted about this issue, and it was stated that the subscale or the number of items could be reduced by making the necessary analyses during the intercultural adaptation process. As a result of the analysis, the "sensory processing" part

was removed from the name of the adapted scale, which led to the scale being renamed as AEFC. From here on, this scale was addressed as AEFC.

Upon examination of the remaining items, it was found that the data was suitable for factor analysis, with the Kaiser-Mayer-Olkin (KMO) value of the scale being .84. The Bartlett Sphericity Test value is .000 ($p < .05$). The common variance values of the scale items range between .40 and .68. Factor determination relied on examining the scatter plot and considering factors with eigenvalues exceeding 1. The scatter plot is provided in Figure 3.

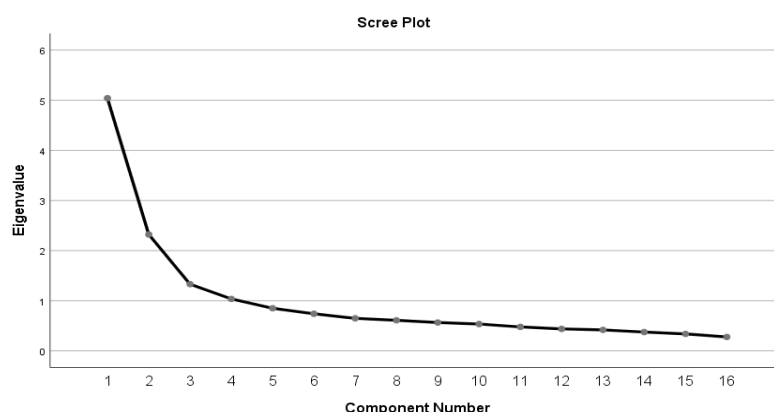


Figure 3. AEFC factor analysis line chart

According to Figure 3, the scale appears not to be separated by a very clear line after the third point; therefore, it can be said that the scale has a three-factor structure. Data related to these components are presented in Table 7.

Table 7.

Number of Factors Based on Eigen Value Statistics and Explained Variance Ratio

Subscales	Initial Eigenvalues			Eigen Sums of Square Loadings		
	Sum	Variance%	Totaled %	Sum	Variance%	Totaled %
Executive attention, working memory	4.637	33.120	33.120	4.637	33.120	33.20
Emotional-behavioral self-regulation	2.293	16.376	49.496	2.293	16.376	49.496
Inhibitory Control	1.256	8.971	58.467	1.256	8.971	58.467

Table 8.

Factor Loadings of the Items in the Rotated Principal Components Analysis Method of the AEFC Scale

Assessment of Executive Functions in Childhood		Factors		
		1	2	3
Executive attention, working memory	I1 Has difficulties in understanding the instructions he/she is given to perform tasks	.785	.122	.085
	I2 Has difficulty following a conversation, activity, or instructions.	.771	.157	.101
	I3 Has problems in selecting the essential information or necessary objects to perform a task or solve a problem.	.760	.117	.132
	I4 Has difficulties doing things that require mental effort.	.751	.119	.048
	I5 Has difficulties performing activities that involve several steps.	.694	.018	.005
	I6 Has difficulties remembering information while he/she is performing another activity.	.676	.120	.080
Emotional-behavioral self-regulation	I7 Protests when does not get own way.	.085	.786	.233
	I8 Reacts inappropriately to criticism.	.171	.760	.121
	I9 Has rapid mood swings.	.019	.738	.173
	I10 Cries and/or gets frustrated easily.	.268	.704	.169
Inhibitory Control	I11 Usually hums or makes noises while he/she performs tasks and should be silent.	.058	.177	.809
	I12 Seeks activities involving jumping, crawling, pressing, pushing, or pulling	.157	.227	.772
	I13 Has difficulties staying still.	.071	.117	.728
	I14 Acts without planning what he/she has to do, in an impulsive way	.212	.263	.538

In Table 7, three factors had eigenvalues greater than 1. The total variance explained by each subscale was 33.12% for executive attention and working memory factor, 16.376% for emotional-behavioral self-regulation, and 8.97% for inhibitory control. These three factors explained 58% of the total variance. The findings related to the factor loadings are shown in Table 8.

According to Table 8, the factor loadings for the executive attention and working memory factor (6 items) range from .67 to .78, for the emotional and behavioral self-regulation factor (4 items) range from .70 to .78, and the inhibitory control factor (4 items) load values vary between .53 and .80.

Confirmatory Factor Analysis (CFA) of AEFC: Confirmatory factor analysis was conducted to evaluate the model obtained from EFA. The data collected from 282 children not included in EFA were used for CFA, and goodness-of-fit values were examined. The value ranges given by Çokluk, Şekercioğlu, and Büyüköztürk (2015) regarding the fit indexes were considered when evaluating CFA results Table 9.

Table 9.

Findings regarding the fit index

Fit Indexes	Perfect Fit Criterion	Good Fit Criterion	Value	Fit Level
χ^2/sd	$0 \leq \chi^2/sd \leq 2$	$2 \leq \chi^2/sd \leq 3$	2.591	good fit
RMSEA	$.00 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$	.07	good fit
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI \leq .90$	.86	good fit
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI \leq .95$	.90	good fit
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$	.91	good fit
IFI	$.95 \leq IFI \leq 1.00$	$.90 \leq IFI \leq .95$	.90	good fit
PNFI	$.95 \leq PNFI \leq 1.00$	$.50 \leq PNFI \leq .95$	.91	good fit
PGFI	$.95 \leq PGFI \leq 1.00$	$.50 \leq PGFI \leq .95$	.70	good fit
NNFI	$.95 \leq NNFI \leq 1.00$	$.90 \leq NNFI \leq .95$	.90	good fit
SRMR	$.00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$	.08	good fit

According to Table 9, the fit indices, $\chi^2/sd= 2.591$, $RMSEA=.07$, $AGFI=.86$, $GFI=.90$, $CFI=.91$, $IFI=.90$, $PNFI=.80$, $PGFI=.70$, $NNFI=.90$ and $SRMR=.08$ values show good fit criterion.

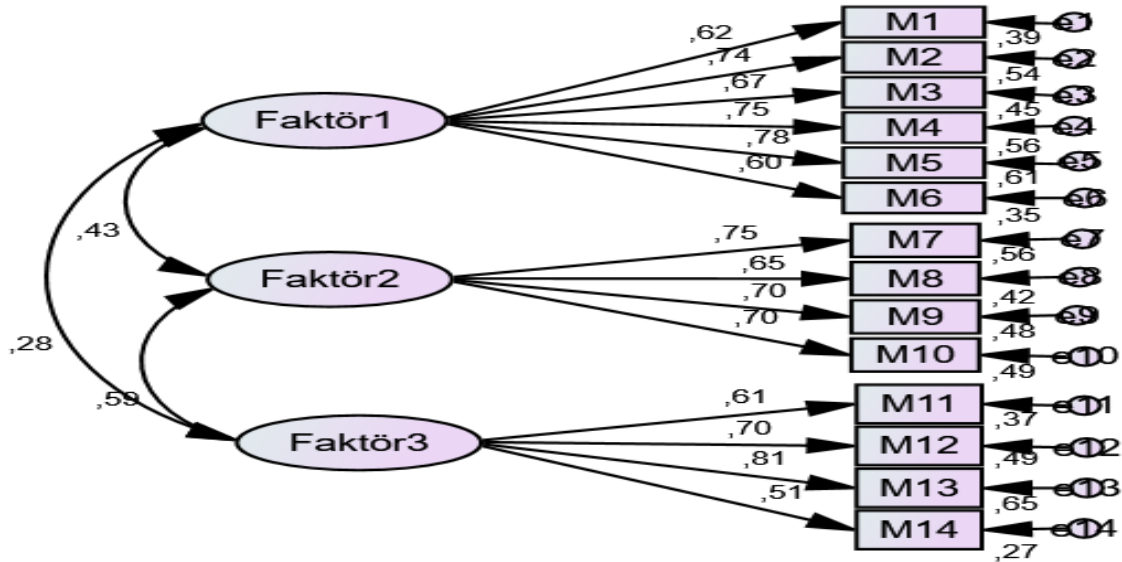


Figure 4. Path diagram obtained by confirmatory factor analysis

Note: Factor 1=Executive attention, Working memory, Factor 2=Emotional and behavioral self-regulation, Factor=3 Inhibitory control.

Based on these CFA results, it can be concluded that the factor validity of fourteen items in the measurement tool was ensured.

Reliability Results of AEFC Scale

Cronbach's Alpha value was computed and presented in Table 10 to determine the scale's internal consistency coefficients.

Table 10.

Internal Consistency Coefficients of AEFC

Subscales	Average	Variance	Standard deviation	Number of Items	Internal Consistency (Cronbach's Alpha) Coefficient
Executive attention, working memory	9.7687	13.591	3.68660	6	.84
Emotional-behavioral self-regulation	14.0176	12.463	3.53033	4	.78
Inhibitory Control	13,6101	14,018	3.74401	4	.72
AEFC Total	30.1410	68.585	8.28160	14	.83

Table 10 shows that the AEFC scale's internal consistency coefficient is .83, and the internal consistency coefficients of its subscales range between .72 and .84.

Discussion, Conclusion, and Suggestions

In recent years, there has been an increase in studies on children's SR skills, leading to the need for scale studies developed or adapted for assessing these skills. In this study, two scales were adapted to Turkish. The first scale is CSBQ, developed by Howard and Melhuish (2017). The second scale is the EPYFEI, developed by Romero-Ayuso et al. (2018) and renamed AEFC after the analysis results of this study. For both scales, expert opinion was taken for the items to determine the content validity index. After these procedures, exploratory factor analysis and confirmatory factor analysis were conducted to examine the scales' construct validity. The concurrent validity was examined only for the CSBQ scale.

The results showed that the content validity index of the CSBQ scale was sufficient. The factor analysis of the CSBQ showed that the scale has a three-factor structure, considering the factors with eigenvalues greater than 1 and the scatter plot. The CSBQ scale consists of three factors: cognitive self-regulation (5 items), behavioral and emotional self-regulation (4 items), and sociability (6 items). CFA results of the CSBQ scale indicated that the scale had a good fit with the 15-item three-factor structure. The result of the concurrent validity between the CSBQ and CBRs scales demonstrated that the highest relationship was between the behavior subscale of the CSBR scale and the cognitive self-regulation subscale of the CSBQ scale.

In terms of the reliability of the CSBQ, the internal consistency coefficient (Cronbach's Alpha value) of the total scale (.84) and its subscales of cognitive self-regulation (.78), behavioral and emotional self-regulation (.74), and sociability (.80), respectively, are at a good level. There are other studies in which the CSBQ is used as a measurement tool (Howard, 2020; Huang, Geng, & Siraj, 2022; Williams & Bentley, 2021). For example, in their study, Williams and Bentley (2021) used three subscales of CSBQ. They found that Cronbach's Alpha values were 0.87 for the cognitive self-regulation dimension, 0.91 for the behavioral self-regulation dimension, and 0.83 for the emotional self-regulation dimension.

When the results of the AEFC scale were examined, it was found that the content validity index of the AEFC scale was at a sufficient level. The factor analysis conducted to determine the construct validity of the AEFC demonstrated that the scale has a three-factor structure, considering the factors with eigenvalues greater than 1 and the scatter plot. The AEFC consists of the executive attention and working memory factor (6 items), emotional and behavioral self-regulation factor (4 items), and inhibitory control factor (4 items). The values found as a result of CFA for the AEFC scale are similar to those of Çokluk et al. (2012) according to the value ranges given for fit indices. Hence, it was concluded that the scale had a good fit with the 14-item three-factor structure. In terms of the reliability of the AEFC, the internal consistency coefficient (Cronbach's Alpha value) of the whole scale (.83) and its subscales of executive attention and working memory (.84), emotional, behavioral self-regulation (.78), and inhibitory control (.72) are good, respectively. The total and subscales of this

measurement tool are highly reliable, as these values correspond to the high-reliability interval stated in the literature (Kalyacı, 2016). There are other studies in which AEFC was used as a measurement tool, and the sample group consisted of children outside the preschool period (6-11 years old) (Romero-Ayuso et al., 2020; Romero-Ayuso et al., 2023).

Considering all the findings of both scales, it is evident that the values related to the adapted CSBQ and AEFC measurement tools are within a highly reliable range. The CSBQ and AEFC measurement tools contribute to the field because they are time-saving, short, and quickly applicable and can be used in low-resource environments. As a result, it has been determined that the self-regulation and social development skills of 4–6-year-old children can be assessed validly and reliably by using CSBQ, based on teachers' opinions, and the executive functions of 4–6-year-old children can be determined validly and reliably, based on parents' opinions, by using AEFC.

This study is limited to 454 children with middle socioeconomic levels, their parents, and their teachers who attend preschool education in a district in the southwest of Turkey in the 2021-2022 academic year. Future studies would help verify the internal consistency and validity of the scale with data collected from sample groups with different socioeconomic and sociocultural characteristics. It has been stated that the original version of the CSBQ (Howard & Melhuish, 2017) and AEFC (Romero-Ayuso et al., 2018) scales can also be applied to children in the 3-year-old group. For this reason, in future studies, the validity and reliability of these scales can be conducted for 3-year-old children. In addition, developing performance-based scales or carrying out adaptation studies may help add measurement tools to the literature to determine children's SR skills.

The measurement tools adapted in this study can contribute to planning different studies regarding children's SR, such as relational or semi-experimental ones, in the literature. For instance, these scales can be used for relational research with various variables, such as children's cognitive skills (like problem-solving, reasoning, and academic skills), social skills (like behavioral issues and helpful behaviors), and motor skills that might be associated with the dimensions of SR. Moreover, these tools can promote efforts to identify children at risk regarding SR skills and the planning and implementation of intervention training programs to improve such skills.

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Professional Competencies for the Education of Gifted Students¹

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Abstract

The aim of this study is to determine teachers' views on their professional competencies for the education of gifted students. Qualitative case study design was used in the study. The participants of the study consisted of thirty-seven teachers working at different educational levels who had experience working with gifted students. The data collection tool was a semi-structured interview form developed by the researcher. Content analysis was used to analyze the research data. The research findings consisted of five themes: professional development, communication with gifted students, teaching and learning process, relationships with family, school and society, personal characteristics and professional values. In the research, the most important competencies that teachers should have in the field of professional development were determined as; providing continuous professional development, following innovations in the field, being competent in using technology, knowing students cognitively, emotionally and socially. Additional professional development competencies were determined as teachers developing children's research skills, giving additional tasks focused on talent, activating curiosity, having student-centered communication skills, teachers having field knowledge, making student-centered enrichments in the education program, having professional knowledge, being able to organize student-centered activities, using different methods and techniques in teaching processes. As a result of the research findings, it was suggested that the number of trainings and seminars that can provide continuous professional development of teachers and support them in the field of education should be increased, and the publications that teachers can follow innovations and developments should be increased and made accessible.

Keywords: Gifted, education of the gifted, teacher, teacher professional competencies.

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Introduction

Intelligence and ability are concepts that have been debated and the focus of researchers for many years. The concept of the gifted has been the subject of research for more than a hundred years, various theories have been proposed and different models have been developed (Donovan & Cross, 2002). When the literature on gifted children is examined, it is seen that concepts such as “gifted”, and “giftedness” are generally used (Renzulli, 2016; Renzulli & Reis, 2021; Sternberg & Ambrose, 2021). In the Regulation on Special Education Services in Türkiye (2018), these individuals show an extraordinary level of success or potential for success in the areas of creativity, leadership, and arts compared to their peers.

It was determined that gifted children can organize their thoughts quickly, exhibit spontaneous reading and writing skills in preschool period because they have a strong memory, and can concentrate on higher-level mental skills required for abstract thinking, and logical and complex problems (Sak, 2020; Webb et al., 2016). More and more research in this field is being added every year and the interest in the education of gifted students is increasing. With the increase in this awareness in Türkiye, educational policies have been developed to train teachers and open educational institutions for the education of gifted students. In the education of gifted students, the professional competencies of teachers who will take part in the education of gifted students are as important as the institutions and teaching environments provided for their abilities.

The teaching profession is a field of study that requires knowledge and skills that require special expertise in the social, cultural, economic, scientific, and technological aspects of education (Şişman & Acat, 2003). Teaching is an important profession that requires using professional knowledge and skills effectively in all educational fields or environments (Albarra Shidiq et al., 2022). Teachers have important influences at many points such as the curriculum, the creation of the learning environment, achieving learning goals, and supporting individual students (Gross, 2003). In the education of gifted students, teachers are very important in recognizing students with potential and developing the talent areas of these students, as teachers' professional competencies, knowledge, skills and attitudes, and teacher training on how to treat students are very important (Khalil & Accariya, 2016; Smeets et al., 2023). For this reason, ideal teacher competencies for the education of gifted students have been among the focus topics in recent years and have been the subject of many studies (Ford & Trotman, 2001; Chan, 2011; Cheung & Hui, 2011; Gómez-Arizaga et al., 2016; Litster & Roberts, 2011; Nelson & Prindle, 1992; Saadu et al., 2024). Gifted students need the support and guidance of the teacher to achieve their full potential (Coleman & Cross, 2021; De Boer et al., 2013). The inadequacy of teachers' knowledge, competence, and attitudes towards gifted students is an important problem for gifted students and the welfare of society (VanTassel-Baska & Stambaugh, 2005; Organization for Economic Cooperation and Development, [OECD], 2010). Because students whose educational needs are not met fail, lose their talents, and may even have to drop out of school (Hansen & Toso, 2007; Rone et al., 2023). For this reason, teachers should know the cognitive, physical, social, linguistic, emotional, and cultural development of the students in their class, their learning styles, their strengths and weaknesses, and their interests and needs (Şahin, 2015).

Regarding the characteristics that teachers who work with gifted students should have, researches have highlighted characteristics such as a sense of humor and enthusiastic teaching, interest and respect for the student, flexibility in teaching, being creative, encouraging discussion and thought, and having sufficient field knowledge (Mills, 2003; Wendel & Heiser, 1989). Teachers' pedagogical content knowledge, willingness to teach, and self-regulation skills directly affect the quality of teaching and students' course achievement (Blömeke et al., 2016; Kunter et al., 2013). The professional competencies that teachers should have are positive attitudes towards their profession (Liakopoulou, 2011; Tanang & Abu, 2014), as well as the adequacy of their professional knowledge and skills in terms of both quantity and quality to perform their profession effectively (Bertschy et al., 2013; Call, 2018; Darling-Hammond, 2016; Goodwin, 2021). In addition, teachers' personal qualities also affect students' academic and social development (Danisman et al., 2019; Lopez-Martinvd., 2023). In the literature, teachers' personal qualities are listed as being loving, being open to innovations, being fair, thinking empathically, managing change, communicating effectively with students, valuing students, inspiring students, having moral values, having humor, adapting to

teamwork, being tolerant, and creativity (Arnon & Reichel, 2007; İlğan, 2021; Khalilzadeh & Khodi, 2021; Paine et al., 2016).

Teachers have an important role in identifying gifted students, developing their potential, and supporting them in line with their abilities (Piske et al., 2017; Shabani & Atanasoska, 2021). In the studies conducted, it has been determined that teachers working with gifted students i) develop different strategies for acquiring knowledge and learning, ii) focus on students' learning goals, iii) design learning environments suitable for learning goals, iv) support students in in-school and out-of-school environments in line with their abilities and goals (Akar, 2021; Hong et al., 2011). Gifted students, on the other hand, drew attention to teachers' personality traits such as being knowledgeable, understanding, fair, disciplined, experienced, and using the language correctly (Erişti, 2012).

Aim of Study

With the increasing awareness of individual differences and gifted students and the increase in educational identification instruments, gifted students can be identified at an early stage. Gifted students receive education in the same classrooms as their peers at different levels of education and different grade levels. In this context, every teacher is likely to encounter gifted students in their professional lives. In order to meet the academic and social needs of gifted students, teachers need to have some professional competencies to make student-centered instructional regulations in the classroom, teaching processes, and learning environments. Teachers who do not have professional competencies for the education of gifted students or who partially have these competencies may be inadequate to meet the academic and social needs of gifted students, and cannot provide the academic knowledge and success that students need with the effect of the innovations brought by technology, and cannot support the development of students in line with their abilities. Along with all the students in the class, the teacher should guide the student with special talent potential and his/her family, support and guide the student and family in supporting the development of the student. In this context, determining professional competencies for the education of gifted students can contribute to the professional development of teachers, as well as the preparation of more qualified learning processes for gifted students and the development of their abilities. Teachers are key to recognizing students with special talents and supporting them in line with their talents. Because teachers who have positive attitudes toward students with special talents and professional qualifications can contribute to the development of students' talents and their real potential. Similarly, each student who demonstrates their potential is likely to contribute as a very important human resource for the development of the country. In this respect, determining teachers' competencies for the education of students with special talents is very important for the development of the education of students with special talents and for revealing students' potential. This study aimed to determine the professional competencies of teachers working with gifted students in the context of teacher views.

Method

Research Model

In this research, in which the professional competencies of teachers were examined in the context of teachers' opinions, the case study design, which is one of the qualitative research methods, was used. Qualitative researches are studies that follow qualitative processes by using qualitative data collection techniques such as unstructured or structured interview methods and document analysis to reveal phenomena and events in their natural environment realistically and comprehensively (Yıldırım & Şimşek, 2021). The case study is a research design in which the researcher analyzes a situation, program, event, action, process, or individual in depth. In this design, the researcher collects detailed information (Stake, 1995; Yin, 2009).

Participants

In the study, criterion sampling, one of the purposeful sampling methods, was used to determine the study group. Criterion sampling is the study of all situations that meet a predetermined set of criteria (Yıldırım and Şimşek, 2021). The participants of the study consisted of thirty-seven teachers who were reached by criterion sampling method and experienced in the education of gifted students, working in

primary, secondary, high schools, and SACs in the central district of Düzce province in the 2023-2024 academic year. Demographic information of the teachers participating in the study is given in Table 1.

Table 1.

Demographic Characteristics of Participant Teachers

Code	Gender	Educational Background	Institution	Participation in PDA for the Education of Gifted Students	Seniority	Seniority in Gifted Student Education
T1	Female	Bachelor's Degree	Primary School	Yes	13	4
T2	Male	Bachelor's Degree	Middle School	No	12	2
T3	Female	Bachelor's Degree	Primary School	Yes	16	6
T4	Male	Bachelor's Degree	SAC	Yes	23	7
T5	Female	Undergraduate Degree	Primary School	Yes	17	15
T6	Female	Undergraduate Degree	SAC	Yes	22	1
T7	Male	Bachelor's Degree	Middle School	No	12	1
T8	Female	Undergraduate Degree	Middle School	No	14	4
T9	Female	Undergraduate Degree	SAC	Yes	10	5
T10	Male	Undergraduate Degree	Primary School	Yes	18	7
T11	Male	Bachelor's Degree	Middle School	No	12	1
T12	Male	Bachelor's Degree	Middle School	No	12	1
T13	Female	Bachelor's Degree	Primary School	Yes	26	7
T14	Female	Undergraduate Degree	Primary School	Yes	25	20
T15	Female	Bachelor's Degree	Middle School	Yes	10	10
T16	Female	Bachelor's Degree	High school	Yes	9	0
T17	Female	Undergraduate Degree	SAC	Yes	9	7
T18	Male	Undergraduate Degree	Middle School	Yes	18	10
T19	Male	Undergraduate Degree	Middle School	Yes	18	10
T20	Male	Bachelor's Degree	Middle School	Yes	16	5
T21	Female	Bachelor's Degree	Middle School	No	5	1
T22	Male	Undergraduate Degree	SAC	Yes	25	3
T23	Female	Bachelor's Degree	Primary School	Yes	24	5
T24	Male	Bachelor's Degree	SAC	No	6	2
T25	Female	Bachelor's Degree	SAC	Yes	24	7
T26	Female	Undergraduate Degree	SAC	Yes	25	3
T27	Female	Bachelor's Degree	SAC	Yes	13	6
T28	Female	Bachelor's Degree	Primary School	No	9	8
T29	Female	Bachelor's Degree	High school	No	15	1
T30	Female	Bachelor's Degree	SAC	Yes	29	11
T31	Male	Bachelor's Degree	SAC	Yes	23	5
T32	Female	Bachelor's Degree	Primary School	Yes	26	2
T33	Male	Undergraduate Degree	Primary School	Yes	20	10
T34	Male	Bachelor's Degree	Primary School	No	36	10
T35	Male	Bachelor's Degree	Primary School	Yes	19	8
T36	Female	Undergraduate Degree	Middle School	Yes	11	4
T37	Female	Undergraduate Degree	SAC	No	16	7

PDA: Professional Development Activities

Data Collection Tool

The data collection tool used in the study was prepared by the researchers as a single open-ended question to obtain rich data from the participants. The prepared question was subjected to the review of two and one measurement experts on the education of gifted students. After the experts gave a positive opinion on the question, a pilot application was carried out for the clarity and content validity of the question. As a pilot study, 5 teachers were asked a single open-ended question. The answers were analyzed by the researchers. It was agreed that the single question met the criteria of usefulness, validity, and reliability in obtaining rich data. In the first part of the data collection tool, there were items related to demographic information such as gender, education level, institution of employment, participation in professional development activities for the education of gifted students, seniority in the profession, and seniority in the education of gifted students. In the second part, there was one semi-structured question about the characteristics that teachers should have. This question was; "In your opinion, what are the professional competencies that teachers working with gifted students should have? Please explain in detail." After obtaining the necessary legal permissions, the data were collected by sending the semi-structured interview form online to volunteer and willing teachers

working as teachers in the Central District of Düzce Province. The opinions were collected between November 30, 2023, and December 22, 2023. Teachers' opinions were collected through an open-ended questionnaire sent to teachers. Before the questionnaire was sent to the students, informed consent was requested for participation in the research. The form was terminated for participants who did not give consent for participation in the form. Ethics committee approval was obtained before the research, and research implementation permission was obtained after the ethics committee approval.

Data Analysis

In the study, content analysis and descriptive analysis were used to analyze teachers' opinions. Content analysis aims to reach concepts and themes that will express the research findings by analyzing the data (Mayring, 2015). Descriptive analysis, on the other hand, enables the analysis of data according to their frequencies according to the determined themes (Ekiz, 2020). In the research, content analysis was used in the analysis of data according to themes, and descriptive analysis was used in the frequency and interpretation of opinions. The opinions obtained in the research were transcribed and transferred to prose writing and a 7-page data file was created. The participants' responses were coded independently by the researchers, and themes and sub-themes were reached from the codes. The intercoder agreement was calculated as 95%. Then, the themes and sub-themes formed as a result of the coding were compared and the codes that could not be reconciled were re-evaluated. The compatibility of the themes and subthemes with the codings created by the researchers was subjected to peer review by two field experts and one measurement and evaluation expert. The reliability rate of coding agreement between expert opinions was 93% (Miles & Huberman, 2015). In line with the expert opinions, the sub-themes of three codes and the themes of two codes were changed and the themes and sub-themes were finalized. The findings were supported by giving direct quotations of the participants' views on the theme and sub-themes. Each teacher was given a code in direct quotations (Teacher 1, T1; Teacher 2, T2.....; Teacher 37, T37). Table 2 shows teacher opinions and a coding example based on these opinions.

Table 2.

An Example Of Coding Teachers' Opinions

Teacher's statement (in raw form)	Code(s) containing the statement
To be able to use the most effective teaching methods and techniques ⁽¹⁾ , to provide the required guidance ⁽²⁾ , use effective instruments to recognize the gifted student both cognitively ⁽³⁾ , and emotionally ⁽⁴⁾ , competence in the use of technology ⁽⁵⁾ , being able to improve oneself by following current developments in the area of gifted education ⁽⁶⁾ .	1. Using methods and techniques suitable 2. Guidance 3. Knowing the student with his/her cognitive characteristics 4. Knowing the student with his/her emotional characteristics 5. Competence in using technology 6. Providing continuous professional development

Validity and Reliability: Validity in qualitative research includes the credibility and transferability of data; Reliability is used to define criteria regarding the consistency and confirmability of data (Creswell, 2013; Merriam & Tisdell, 2016).

Credibility: In determining the purpose of the research, creating the data collection tool, collecting, analyzing, and interpreting the data, long-term study and interaction were achieved on the data, and the data was described and interpreted in detail (Stahl & King, 2020). In the study, participants were diversified to create different perspectives among the participants, and researchers and co-experts were diversified to increase reliability in the analysis of the data (Patton, 2014). In order to prevent errors arising from subjective assumptions in the data analysis process, the codes, sub-themes, and themes obtained were presented to four participants, and member checking was obtained from the participants regarding the accuracy of the data (Birt et al., 2016; Candela, 2019).

Transferability: Within the scope of the transferability studies, the raw data obtained were coded by the researchers without adding interpretation, independent of their prejudices, by describing the raw

data. Criterion sampling, one of the purposeful sampling methods, was used in the selection of participants, and the criterion for participating in the study was stated as being experienced in the education of gifted students. In order to reliably determine the professional competencies for the education of gifted students, participants were selected as experienced or postgraduate-level learners. The characteristics of the participants were explained in detail (Table 1). The researchers were teachers who had professional experience in the education of gifted students and had research on the education of gifted students. In order to collect in-depth data, the opinions of a sufficient number of participants (37 teachers) were obtained (Shenton, 2004).

Reliability: The purpose of the research was explained in detail, and the method was determined in accordance with the purpose. Coding was based on raw data. The opinions of different field experts were utilized in the development of the data collection tool. Pilot interviews were conducted with five teachers for the comprehensibility of the draft interview form (Lincoln & Guba, 1986; Shenton, 2004). The themes and sub-themes obtained as a result of coding were subjected to researcher and peer expert supervision (Stahl & King, 2020). The reliability rate of coding agreement between researchers was 95% and the reliability rate of coding agreement between expert opinions was 93% (Gentles et al., 2015, Miles & Huberman, 2015).

Confirmability: Confirmability means that all information and data related to the research process for the control of the research process are examined when necessary. In this way, the research process can be examined and the studies can be confirmed (Creswell, 2013). In this study, the raw data obtained within the scope of the verifiability strategy, analysis processes, coding, tables related to the themes and sub-themes, and the notes taken were archived in the computer environment of one of the researchers to be confirmed when necessary. Data analysis was triangulated by the researcher and data analysis was triangulated by the co-expert (Oliver-Hoyo & Allen, 2006).

Findings

The data obtained from the interviews with thirty-seven teachers participating in the research were analyzed and five themes were reached. These themes are given below;

Theme 1. Teachers' Competencies in Professional Development

Theme 2. Teachers' Competencies in Communication with Specially Gifted Students

Theme 3. Teachers' Competencies in the Teaching-Learning Process

Theme 4. Teachers' Competencies in Relationships with Family, School and Society

Theme 5. Teachers' Competencies in Personal Characteristics and Professional Values

Theme 1. Teachers' Competencies in Professional Development

Teachers' views on the theme of teachers' competencies in the field of professional development are given in Table 3.

Table 3.

Teachers' Competencies in Professional Development

Theme	Teacher competencies	Frequency
Professional development	Providing continuous professional development	19
	Following innovations in the field	13
	Proficiency in the use of technology	8
	Competence in project writing and management	6
	Being a researcher	5
	Being open to innovations	5
	Having 21st-century skills	2
	Producing scientific products	2
	Postgraduate education in the field of expertise	1
	Specialization in the field	1
	Following scientific studies	1
	Ability to develop content	1

In the professional development theme, opinions were given as twelve sub-qualifications, and direct quotations from these opinions are given below;

“...I believe that all teachers, not only those who teach these students, should be provided with the necessary professional knowledge about the characteristics of gifted students, the process of identification, and how to apply them in the education process (T12).”

“Teachers should have the necessary technology usage in a professional sense. They should attend courses, workshops, and symposiums to improve themselves (T23).”

“They should be able to use technology actively and guide students (T25).”

“...competence in the technological field, mastering 21st-century skills, having knowledge and experience in project production and project development, etc. (T27).”

“Field knowledge, educational technologies, project development competence, web 2.0 technologies, should be experts in the fields (T31).”

The competencies that teachers should have regarding professional development are determined as providing continuous development, following developments in their field, being open to innovations, having the ability to use technology, having the ability to write and manage projects, being a researcher, having 21st-century skills, producing scientific products, having postgraduate education in their field, specializing in their field, following scientific studies, and being able to develop content.

Theme 2. Teachers' Competencies in Communication with Gifted Students

Teachers' opinions on the theme of teachers' competencies in the field of communication with gifted students are given in Table 4.

Table 4.

Teachers' Competencies in Effective Communication

Theme	Sub Themes	Teacher competencies	Frequency
Effective Communication	Skills for recognizing gifted students	Cognitive recognition of the students	5
		Knowing the student emotionally	4
		Recognizing/known students' personal characteristics	2
		Knowing the developmental characteristics of the student	2
		Getting to know the student socially	2
		Knowing the characteristics of students	1
	Interaction with students	Supporting students' imagination and productivity	3
		Developing children's research skills	1
		Stimulating children's sense of curiosity	1
		Having student-centered communication skills	1
		One-on-one attention in the classroom/teaching	1
		Give additional tasks to develop capability	1

Teachers' views on the theme of competencies that teachers should have while communicating with their students are grouped under two sub-themes: student recognition skills and interaction with students. The following are direct quotations from teachers' views on the theme of their competencies in communicating with their students;

“The personal characteristics of these students must be recognized (T6).”

“They should know the characteristics of gifted students (T8).”

“They should have knowledge about the characteristics of the students, know their emotional characteristics, know them well, and be able to prepare activities appropriate to their level (T30).”

“They should have good communication (T33).”

When the teachers' views on the theme of communication with students are evaluated, it is seen that knowing students cognitively, emotionally, and socially are important competencies in the dimension of knowing students. In addition, knowing students' personal characteristics and developmental characteristics were identified as other competencies related to knowing students. In the dimension of interaction with students, teachers' supporting students' imagination and productivity, developing students' research skills, giving additional skill-oriented tasks, stimulating their curiosity, and having student-centered communication skills were identified as other important professional competencies related to communication.

Theme 3. Teachers' Competencies in the Teaching-Learning Process

Teachers' views on the theme of teachers' competencies in the teaching-learning process are given in Table 5.

Table 5.

Teachers' Competencies in the Teaching and Learning Process

Theme	Sub Themes	Teacher competencies	Frequency
The process of teaching and learning	Instruction	Having field education/knowledge	8
		Making student-centered enrichments in the education program	7
		Having professional knowledge	7
		To be able to organize student-centered activities	6
		Utilizing different methods and techniques in teaching processes	5
		Making student-centered adaptations in the education program	3
		Activating students' higher order thinking skills	3
		Using the most appropriate methods and techniques for teaching	3
		Making student-centered adaptations in teaching processes	3
		Utilizing tools and materials to make teaching effective	3
		Making student-centered adaptations in measurement and evaluation	3
		Designing the teaching process according to the student	2
		Preparing activities for higher order thinking skills	2
		Teaching to improve knowledge	1
		Ability to organize educational environments	1
		Effective planning of training processes	1
		Reorganizing the learning environment according to student feedback	1
		To be able to make group work according to student abilities	1
		Developing students' scientific writing skills	1
		Emphasizing process-oriented development	1
	Classroom management	Guiding students in the learning process	4
		Creating a democratic classroom environment	2
		Motivating the student	2
		Creating a positive learning environment	1

Teachers' views on the theme of teachers' competencies in the field of the teaching-learning process were grouped under two sub-themes: teaching and learning and classroom management. Direct quotations from these opinions are given below;

“They should be able to use the most appropriate teaching methods and techniques (T2).”

“They should have professional knowledge, field knowledge, and field education knowledge. They should be able to construct the teaching process according to the student and apply the methods, techniques, and strategies correctly and appropriately. They should be able to apply the measurement

and evaluation process appropriately for the student and reorganize the teaching and learning process if necessary (T3).”

“They should have the knowledge and skills to create a democratic, innovative, and collaborative classroom environment that will support students' imagination and productivity. They should plan the education program they implement in the classroom in accordance with the individual interests and needs of the students and update these studies when necessary in the process. They should have the knowledge and experience to create a positive classroom environment by enriching the education program with activities that will make children aware of their individual talents (T7)”

“In order to trigger students' different thinking skills, they should ask additional questions, support them with additional tasks and responsibilities, spend one-on-one time in the classroom to develop their skills, and have them do additional work (T10)”

“A process-oriented approach should be followed by moving away from a result-oriented approach. The student should be given the opportunity to express himself/herself, his/her work should be evaluated from his/her perspective and motivation should be strengthened so that the student can use his/her performance at the highest level (T15).”

“They should be capable of creating enriched education plans (T35)”

When teachers' views on the teaching and learning process were evaluated, the most important competencies were determined as having field knowledge, making student-centered enrichments in the curriculum, having professional knowledge, organizing student-centered activities, and using different methods and techniques in teaching processes. Moreover, making student-centered adaptations in the curriculum, activating students' higher order thinking skills, using the most appropriate methods and techniques for teaching, making student-centered adaptations in teaching processes, making use of tools and materials that will make teaching effective, making student-centered adaptations in measurement and evaluation, and constructing the teaching process according to the student. Other competencies related to the teaching and learning process were identified as preparing activities for higher order thinking skills, the ability to organize educational environments to teach knowledge development, planning educational processes effectively, reorganizing the learning environment according to student feedback, having group studies according to student abilities, developing students' scientific writing skills and caring about process-oriented development.

When the classroom management dimension of teachers' views on the teaching and learning process is examined, the competency that is thought to be the most important is guiding students. In addition, creating a democratic classroom environment, motivating students, and creating a positive learning environment are the competencies that teachers think should be in the field of classroom management.

Theme 4. Teachers' Competencies in their Relations with Family, School and Society

Teachers' views on the theme of teachers' competencies in their relations with family, school, and society are given in Table 6.

Table 6.

Teachers' Competencies in their Relations with Family, School and Society

Theme	Sub Themes	Teacher competencies	Frequency
Family, school, and society relations	Within School	Having communication skills for stakeholders within the school	5
		Organize joint activities to improve peer interaction	2
		Collaboration with colleagues	2
	Outside of school	Cooperation with the family	3
		Guiding the family	3
		Collaborating with experts from different disciplines	1
		Following the student's SAC program	1
		Directing students to out-of-school learning environments	1

Teachers' views on the theme of teachers' competencies in their relations with family, school, and community were grouped under two sub-themes: inside and outside the school.

Below are direct quotations from teachers' views on the theme of teachers' competencies in their relations with family, school, and society;

“They should support/guide students and families in line with their abilities (T8).

“They should be in cooperation with the family, and if they go to SAC, they should be in contact with the teachers there (T10).”

“They should direct the student to out-of-school development environments (T18).”

“It is necessary to act in cooperation with the teachers in the class, to exchange information with the parents of the students, and to keep in touch with them (T19).”

When the competencies of teachers working with gifted students in their relationships with the family, school, and society are examined within the school, having communication skills for the stakeholders within the school is the most important, while organizing joint activities to improve peer interaction and being in cooperation with the teacher's colleagues were determined as important competencies. In the dimension of teachers' relationships outside the school, teachers' cooperation with the family and providing guidance to the family were identified as important competencies. In addition, it was determined that they should have competencies such as collaborating with different interdisciplinary experts, following the student's SAC program, and directing the student to out-of-school learning environments.

Theme 5. Teachers' Competencies in Personal Characteristics and Professional Values

Teachers' views on the theme of teachers' competencies personal characteristics and professional values are given in Table 7.

Table 7.

Teachers' Personal Characteristics and Professional Values

Theme	Sub Themes	Teacher competencies	Frequency
Personal characteristics and professional values	Personal characteristics	Having creative personality traits	4
		Producing practical solutions to problems	2
		Having a developed sense of empathy	2
		Patience	2
		Being a good observer	2
		Respect for differences	2
		Interest in art	1
		Being a good listener	1
		Being open to criticism	1
		Having broad interests	1
		Foresightedness	1
		Setting an example with perseverance and hard work	1
	Professional values	Having professional values	2
		Developing positive attitudes towards gifted students	2
		Complying with professional ethical rules	1

Teachers' views on the theme of teachers' competencies in the field of personal characteristics and professional values were grouped under two sub-themes: characteristic features and professional values. Direct quotations from these opinions are given below;

“He/she should be patient, researcher, and innovative (T14).”

“They should like research, follow scientific studies and produce scientific studies, be innovative, like to develop, productive, have flexibility, have developed communication skills, be a good listener, have high empathy skills (T17).”

“They should be curious, open to innovations, learn together with students, patient, creative, self-developing (T26).”

“Being reliable, cultural and academic development, multidimensional thinking, extensive professional experience, respect for individual differences, being democratic, cooperative and innovative (T27)”

“They should be creative, flexible, open to innovations and researchers (T29).”

When the theme of teachers' personal characteristics and professional values was examined, having creative personality traits was stated as the most important competency among teachers' personal characteristics. In addition, producing practical solutions to problems, having a developed sense of empathy, being patient, being a good observer, respecting differences, being interested in art, being a good listener, being open to criticism, having broad interests, being farsighted and being an example with perseverance and diligence were identified as other competencies in the theme of teachers' personal characteristics and professional values. In the professional values dimension, teachers' having professional values, developing positive attitudes towards gifted students, and complying with professional ethical rules were identified as other important professional values.

Discussion, Conclusion, and Suggestions

When the results of the research were examined, professional development, communication with gifted students, learning-teaching process, relations with family, school, and society, personal characteristics, and professional values were emphasized as areas of teacher competence. It is seen that similar areas are emphasized in the studies on professional competencies of teachers working in the education of gifted students (Chan, 2001; Ćotar Konrad & Kukanja Gabrijelčić, 2015; Gómez-Arizaga et al., 2016; Heath, 1997; Mills, 2003; Saadu et al., 2024; Vogl & Preckel, 2014).

It was determined that teachers working with gifted students should have competencies such as following the developments in their field, being open to innovations, having competence in the use of technology, having competence in writing and managing projects, being a researcher, having 21st-century skills, producing scientific products, doing postgraduate education in their field, specializing in their field, following scientific studies, and developing content. Because these competencies reflect the teacher profile that adapts to the changes taking place today in revealing the potential of gifted students (Adeoye et al., 2024).

Continuing post-service professional development of teachers working with gifted students is as important for their professional competencies as pre-service training (Croft, 2021). When the competency areas for professional development are examined, teachers need to constantly renew themselves to effectively support and guide gifted students. In similar studies, it is noteworthy that research findings on the active professional development of teachers to develop and renew their professional skills are also noteworthy (Neumeister et al., 2007). However, it was emphasized that teachers' pre-service training was not sufficient in the context of gifted education and that professional development was important in this context (Fraser-Seeto, 2013; Rowley, 2012; Sayi, 2018). However, when the relevant literature was examined, it was determined that the professional development of teachers for the education of gifted students was inadequate (Kalobo & Setlalentoa, 2024; Poulos & Jung, 2024). Inadequate professional development of teachers stands out as an important problem in terms of obtaining the expected qualified outcomes in the education of gifted students.

When the teachers' views on the theme of communication with students were evaluated, it was seen that knowing students cognitively, emotionally, and socially are important competencies in the dimension of knowing students. In addition, knowing the student's personal characteristics and developmental characteristics were identified as other competencies related to knowing the student. The first step in identifying the needs of gifted students, planning instruction to meet the needs of the student, and designing effective instructional processes is to know the student (Gómez-Arizaga et al., 2016; Shaughnessy & Senior, 2022; VanTassel-Baska & Johnsen, 2007; VanTassel-Baska & Baska, 2021). The inadequacy of teachers' knowledge, competence, and attitudes towards gifted students is an important problem for the welfare of gifted students and society (VanTassel-Baska & Stambaugh, 2005; OECD, 2010).

In the research findings, in the dimension of interaction with students, teachers' supporting students' imagination and productivity, developing students' research skills, giving ability-oriented additional tasks, activating their sense of curiosity, and having student-centered communication skills were identified as important professional competencies. In similar studies, there are similar findings in terms of mobilizing students' sense of curiosity (Akar, 2021; Saadu et al., 2024), giving ability-oriented challenging additional tasks (De Boer et al., 2018; Matheis et al., 2017) to guide gifted students correctly and support them in line with their abilities. Both of these teacher competencies are very important in terms of developing students' talents and sustaining talent development. Project-based research activities have an important place in the education of gifted students. In this context, students need to acquire scientific research skills and produce solutions to different problems with interdisciplinary thinking skills (Hess, 2021; Makkonen et al., 2021). In addition, students need to have research skills to have in-depth learning experiences and original studies in their fields of interest (Brown & Seymour, 2021). Teachers are role models in providing students with research skills (Chu, 2008; West Keur, 2019). Communicating effectively with students is among the basic professional skills that teachers should have (Florence et al., 2022; Khalil & Accariya, 2016). Effective communication is one of the key professional competencies for motivating students for learning goals, gaining self-confidence in their abilities, and guiding students effectively in line with their abilities.

When the teachers' views on the teaching and learning process were evaluated, it was determined that having field knowledge, making student-centered enrichments in the curriculum, having professional knowledge, being able to organize student-centered activities, and benefiting from different methods and techniques in teaching processes were the most important competencies in the dimension of education and training. In addition, making student-centered adaptations in the curriculum and teaching processes, making use of methods and tools, and materials that will make teaching effective, planning educational processes effectively, reorganizing the learning environment according to student feedback, and caring about process-oriented development, having group studies according to student abilities, developing students' scientific writing skills, preparing activities to develop higher-order thinking skills, teaching to develop knowledge, were determined as other competencies related to the teaching and learning process. These skills are professional skills that are necessary for teachers to carry out the teaching profession effectively and successfully (Aktan & Budak, 2021). In this context, in the teacher competencies announced by the Ministry of National Education [MoNE], the sub-qualification areas of planning the teaching process, creating learning environments, managing the teaching process, and measurement and evaluation were expressed as sub-qualification areas related to the professional skills competency area (MoNE, 2017). In the studies conducted in the literature, it was determined that as a result of not designing the teaching process for the interests and learning goals of gifted students, students' interest and attention towards the lesson decreased, they exhibited problem behaviors, and thus had problems in realizing their potential (Callahan et al., 2015; David, 2018; Rogers, 2007; VanTassel-Baska & Stambaugh, 2005; Webb, 2005; Yang & Siegle, 2006). Teachers' professional competencies should be improved in terms of planning, implementing, enriching, and evaluating the gifted student-oriented teaching process to sustain the student's gifted development (VanTassel-Baska, 2019; VanTassel-Baska et al., 2021).

When the classroom management dimension of teachers' views on the teaching and learning process is examined, the competency that is thought to be the most important is guiding students. Effective guidance for gifted students contributes to meeting their cognitive, social, and emotional needs and sustaining their talent and career development (Grassinger et al., 2010; Greene, 2005; Little et al., 2010; Levent, 2016). In addition, supporting students' imagination and productivity, creating a democratic classroom environment, motivating students, and creating a positive learning environment are also competencies that teachers are thought to have in the field of classroom management. In different research findings, some findings create a positive and reliable learning environment (Akar, 2020; Gentry et al., 2011; Vogl & Preckel, 2014), creating a democratic classroom environment (Hardar et al., 2020; Lee et al., 2021), developing students' imagination (Altintas & Ozdemir, 2015; Gotlieb et al., 2016; Renzulli et al., 2022), and motivating students (De Boer et al., 2018; Hornstra et al., 2020; Phillips & Lindsay, 2006; Sypré et al., 2023), make significant contributions to the academic and social development of gifted students. However, some students do not receive the necessary academic and social support from their families (Olszewski-Kubilius et al., 2014; Papadopoulos,

2021). For this reason, guidance of teachers towards gifted students is among the most important professional competencies.

When we look at the competencies of teachers working with gifted students in their relationships with family, school, and society within the school, having communication skills for stakeholders within the school is the most important, but organizing joint activities to improve peer interaction and being in cooperation with colleagues are other important professional competencies. When we consider the dimension of teachers' relationships outside the school, teachers must cooperate with the family and guide the family. In addition, it was determined that they should have competencies such as collaborating with different interdisciplinary experts, following the student's SAC program, and directing the student to out-of-school learning environments. In this context, effective communication with teachers within the school supports the professional development of the teacher (Cotabish & Robinson, 2012; Mofield & Phelps, 2021), while effective communication with stakeholders outside the school supports the professional development of the teacher as well as the development of the gifted student (Freeman, 2001; Ritchotte & Zaghlawan, 2019). In order to develop the potential of gifted students in line with their abilities, the teacher must have the ability to collaborate with experts in different fields together with the family (Akar, 2020; Matthews et al., 2007).

When the theme of teachers' personal characteristics and professional values was examined, having creative personality traits came to the fore as the most important competence among teachers' characteristic traits. In similar studies, it was determined that having creative personality traits of teachers improves creative teaching and students' creativity (Al-Dababneh & Al-Zboon, 2017; Chan & Yuen, 2014; Ford & Trotman, 2001; Gralewski & Karwowski, 2018; Horng et al., 2005; Lee & Kemple, 2014). Other characteristics of the teachers in the study were as follows: producing practical solutions to problems, having a developed sense of empathy, being patient, being a good observer, respecting differences, being interested in art, being a good listener, being open to criticism, having broad interests, being forward-thinking, and being an example with perseverance and hard work. Research findings are consistent with similar research findings (Chan, 2001; Khalil & Accariya, 2016; Mills, 2003). Teachers' personality characteristics such as imagination, empathy, patience, perseverance, diligence, and interest in art make student-teacher interaction strong (Kesner, 2005; Klassen & Tze, 2014).

In the professional values dimension, teachers' having professional values, developing positive attitudes towards gifted students, and complying with professional ethical rules were identified as important professional values. Teachers involved in the education of gifted students should take into account the value judgments, strengths and weaknesses, and prioritized needs of students (Matthews & Foster, 2005). In addition, teachers are expected to have professional values such as being supportive of students, patient, respectful, and cooperative. Advisors and mentors in gifted education should understand the structure, culture, and community partnerships of the institution and be patient and collaborative in facilitating relationships. As with teachers working with gifted students, consultants need to be flexible, recognizing that it is sometimes necessary to modify their approach to accommodate teachers' workloads, schedules, values, priorities, comfort levels, instructional preferences, strengths, and weaknesses (Hoth et al., 2017; Matthews & Foster, 2005). When there is a supportive, mutually respectful, and collaborative relationship between mentors and classroom teachers in gifted education, teachers can be productive and fulfilled (Matthews et al., 2007). In 2006, the National Association for Gifted Children & Council for Exceptional Children, and The Association for the Gifted [NAGC/CEC-TAG] set teacher standards for the education of gifted students. Among these standards, professional practices and ethical principles in relation to students are also included.

Conclusion

When the results of the research were evaluated in general, a total of fifty-six sub-qualifications were identified based on the teachers' opinions, including twelve sub-qualifications related to professional development, twelve sub-qualifications related to communication with gifted students, twenty-four sub-qualifications related to learning-teaching process, and eight sub-qualifications related to relations with family, school, and society. For the theme of professional development, competencies such as providing continuous development, following developments in the field, being open to innovations,

having competence in the use of technology, having competence in writing and managing projects, being a researcher, having 21st-century skills, producing scientific products, doing postgraduate education in the field, specializing in the field, following scientific studies, and developing content were identified.

In the theme of communication with students, competencies such as getting to know students cognitively, emotionally, and socially, knowing students' personal characteristics and developmental characteristics, supporting students' imagination and productivity, developing students' research skills, giving students additional talent-oriented tasks, stimulating students' curiosity, and having student-centered communication skills were emphasized. For the teaching and learning process, competencies such as having field knowledge, making student-centered enrichments in the curriculum, having professional knowledge, organizing student-centered activities, using different methods and techniques in teaching processes, making student-centered adaptations in the curriculum and teaching processes, using methods and tools to make teaching effective were expressed. As additional competencies for the teaching and learning process, competencies such as planning educational processes effectively, reorganizing the learning environment according to student feedback and caring about process-oriented development, having group studies according to student abilities, developing students' scientific writing skills, preparing activities to develop higher-order thinking skills, and teaching to develop knowledge were identified. In the classroom management dimension, competencies such as guiding students, supporting students' imagination and productivity, creating a democratic classroom environment, motivating students, and creating a positive learning environment were identified.

It was determined that teachers working with gifted students should have competencies such as having communication skills for stakeholders within the school, organizing joint activities to improve peer interaction and cooperating with the teacher's colleagues, cooperating with the family and guiding the family, cooperating with different interdisciplinary experts, following the student's talent program, directing the student to out-of-school learning environments. As personal characteristics and professional values, professional competencies such as having creative personality traits, producing practical solutions to problems, having a developed sense of empathy, being patient, being a good observer, respecting differences, being interested in art, being a good listener, being open to criticism, having broad interests, being forward-thinking, being an example with perseverance and diligence, and following ethical principles were identified.

Recommendations

Based on the findings of the research, the following recommendations are proposed;

- In-service professional development activities aimed at improving teachers' professional competencies, ensuring their continuous professional development, and developing their research and technological skills can be improved in terms of quantity and quality.
- Publications that teachers can follow the innovations and developments in gifted education can be increased and their accessibility to publications can be ensured.
- The content of pre-service teacher training programs for professional competencies for the education of gifted students can be enriched.
- Teacher professional development programs for the education of gifted students can be prepared, and implemented and their effectiveness can be evaluated to improve teachers' professional competencies.

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we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Investigating Pre-service English Language Teachers' Career Paths and Professional Needs

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Abstract

Understanding the career decisions and professional growth goals of pre-service English Language Teachers (PELTs), it is critical to address the challenges faced by the L2 teaching field for enacting extensive reforms in policies in the second language (L2) teacher education, the allocation of resources, and curriculum development to contribute to the quality of L2 education. Thus, this study investigates the career decisions and professional needs and aspirations of PELTs studying in one of the teacher education programs at a university in Istanbul, focusing on the challenges, opportunities, and perceived gaps. Employing focus group interviews with 30 PELTs and also individual interviews with three of them, we found that there were significant challenges, including the lack of teaching materials and low income, leading to dissatisfaction, burnout, and reconsidering alternative pathways. Workload imbalances, financial security, limited professional development opportunities at state schools were also viewed among the reasons for participants to consider alternative pathways abroad. Based on these findings, for future L2 educators, it is critical to address financial challenges through incentives and offer professional development initiatives, involving international partnerships, might contribute to linguistic and intercultural competencies, creating a more culturally aware teaching workforce.

Keywords: career decision, professional needs, PELTs, career goals

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Introduction

Given a wide range of issues including socioeconomic factors, perceptions about teaching as a profession, and teacher motivation (Darling-Hammond, 2017; Zhang et al., 2020), severe teacher shortages have been a major problem in 30 countries, involving Brazil, Indonesia, Ireland, Mexico, Shanghai-China, Sweden, and Türkiye (Behrstock-Sherratt, 2016; OECD, 2018, 2019). Research shows that there are also concerns about teacher attrition for almost two decades (Noordzij & van de Grift, 2020) and there are major challenges in recruiting subject areas, including foreign language education across different grade levels (Swanson & Mason, 2018). Additionally, research has identified several issues related to the shortage of foreign language teachers, including socioeconomic factors, perceptions about teaching as a profession and teacher motivation (Zhang et al., 2020). Thus, understanding the career choices, goals, and career development needs of these individuals is important to tackle with these issues faced by the teaching profession, including teacher development, teacher quality, and retention (Eren, 2021).

English language teaching (hereafter, ELT) in Türkiye is encountered with diverse challenges that influence the career paths and professional development of PELTs (Valizadeh, 2021). These challenges involve concerns regarding resources, curriculum, over-crowded classrooms, teaching materials and student motivation (Özmat & Senemoğlu, 2020; Öztürk & Aydın, 2019). It is critical to address these challenges that highlight the need for comprehensive reforms in L2 (second language) teacher education policies, resource allocation, and curriculum development to promote the quality of L2 education in the country (Dinçer & Koç, 2020).

Literature Review

Studies has indicated that the professional needs of pre-/in-service teachers are closely linked to their career choice satisfaction and motivation (see Borg, 2015; Eren & Tezel, 2010; Eren, 2015), commitment to teaching (Fokkens-Bruinsma & Canrinus, 2014), and career choice satisfaction (An et al., 2021; Eren, 2012). This evidence shows the necessity of exploring teachers' career plans and professional needs in addressing various challenges in the teaching profession. In addition, the relevant literature has previously demonstrated that many beginning teachers quit teaching within their first five years, resulting in substantial losses in the teaching workforce (Struyven & Vanthournout, 2014). Given the impact of their undergraduate experiences on their teaching motivation and retention (Watt et al., 2014), unveiling pre-service English language teachers (hereafter, PELTs) career plans and professional needs might help address recruitment and retention challenges in the field.

The challenges perceived by PELTs in Türkiye have important implications for their career choices and professional development needs and aspirations. This section reviews previous research on these themes, focusing on the context-specific concerns experienced by PELTs in Türkiye. Previous research has revealed that English language teachers in Türkiye experience a wide range of challenges that impact their teaching practices (British Council, 2018; Valizadeh, 2021). One of these major challenges is related to the restriction on teachers' autonomy in choosing instructional materials, particularly English language teaching (ELT) books which primarily focus on grammar and lack relevant content for enhancing effective communication in the class (Admiraal et al., 2023; Larsen-Freeman, 2015). Additionally, insufficient resources, involving supporting materials and facilities, have shown to prevent effective L2 teaching (Özmat & Senemoğlu, 2020).

Uştuk and Çomoğlu (2019) has found that there are concerns in pre-service language teacher education in terms of lack of opportunities for reflective practice, peer observation, and collaboration with mentors. These challenges need to be addressed since they contribute to the struggle of adapting innovative teaching methodologies to meet the complex demands of the 21st century (Akkaş & Çöker, 2016). Furthermore, scholars have highlighted the need for policy reforms in L2 teacher education in Türkiye to address these concerns (Mahalingappa & Polat, 2013; Öztürk & Aydın, 2019). In that regard, Eken (2021) has indicated that the centralized curriculum, the mismatch between assessment practices and international standards as well as insufficient teacher training pose major problems in the Turkish foreign language education system. The imbalance between teaching and non-teaching duties, including administrative tasks and extracurricular responsibilities, might result in burn out and dissatisfaction among teachers (Solomons & Abrams, 2023). Tackling these challenges requires a holistic perspective

that involve empowering teacher autonomy, providing professional development opportunities, and aligning curriculum and assessment practices with international standards.

Prior studies have also highlighted the important influence of external factors (Chaban et al., 2023) specifically economic challenges in Türkiye, on the career decisions of PELTs. The current situation in the country is reported to result in uncertainty, which pushes many teachers to seek out alternative career paths and explore opportunities for financial security and career advancement in foreign countries (Onyefulu et al., 2023). In that regard, perceived low income in teaching in Türkiye might impact teachers' motivation and job satisfaction (Hoque et al., 2023; Karakış, 2021). L2 teaching in diverse contexts is considered as a rewarding opportunity to have new perspectives on teaching and learning (Oldac, 2023).

To deal with the aforementioned challenges, it is critical for English language teachers in Türkiye to receive sufficient support for professional development (Akkaş & Çöker, 2016). The studies on professional development show that exploring new career opportunities, such as teaching English abroad or enrolling in a master's program in a foreign country is an attractive option among PELTs to achieve their career goals (Jackson, 2016). These studies suggest that there is a need for offering PELTs with a guidance on diverse career options to facilitate the decision-making process about their professional future (Farrell, 2015). Moreover, language teachers perceive short-terms abroad programs, such as the Fullbright Foreign Language Teaching Assistant (FLTA) program, as valuable opportunity for professional growth (Bursalı & Mısır, 2021; Mutlu & Ortaçtepe, 2016; Peker et al., 2020). Such international initiatives are prominent so that language teachers can enhance their teaching skills, cultural competence, and oral language proficiency (Ku, 2023). In response to teachers' concerns about oral proficiency and English language instruction, Chen and Goh (2014) recommended addressing these challenges by engaging in experiences within English-speaking countries.

The studies collectively emphasize that PELTs display varying interpretations of career choice and professional needs. Moreover, these studies highlight the necessity to understand the challenges of these future teachers not only to influence their job satisfaction and well-being but also to contribute to the overall quality of education they would provide to their students. By exploring the areas where PELTs experience challenges, feel less face engaged or require further support, this paper aims to offer suggestions to make policies supporting and improving their professional development. Moreover, the findings of this current study might also guide curriculum developers in providing relevant and meaningful professional development opportunities ensuring continuous improvement in the quality of language learning and teaching. Given the impact of career development on teacher motivation and job satisfaction among PELTs (Hoque et al., 2023), it is critical for teacher education programs to understand future teachers' needs, challenges, and aspirations so that they can offer career guidance and support services to make informed decisions. Thanks to this, teacher education programs could customize their curricula to address these challenges effectively, bridge the gap between theory and practice, offer supportive structures, incorporating mentorship programs, fostering professional networks or programs including short-term study abroad programs, and providing advancement opportunities, which align with the professional needs and goals of PELTs.

The existing literature on teachers' learning have primarily concentrated on what teachers should or need to learn, rather than on what teachers desire to learn (Opfer & Pedder, 2011). This research aims to contribute to the ongoing discussion on teacher learning by exploring how PELTs establish their professional learning goals and needs. In brief, studies (Solomons & Abrams, 2023; Torsney et al., 2019; Watt & Richardson, 2014) indicate a potential significant connection between teachers' aspirations for professional development and career choice satisfaction. However, this aspect has not been thoroughly investigated, and there is a noticeable absence of attention to PELTs' individual professional learning goals in Türkiye.

This paper investigates three PELTs' perceptions about their career choices and professional needs. By exploring their self-narratives obtained via in-depth semi-structured individual and focus group interviews, the study reported in this paper explores the anticipated challenges, the desired development and support opportunities available for professional engagement and growth and the perceived gaps between the expectations and realities. Understanding these PELTs' desires for their professional

engagement and career development would allow researchers to gain insights into the impacts on PELTs' future motivation and career choice satisfaction (Torsney et al., 2019).

In parallel with these research aims, the current study endeavors to find answers to the following questions:

- What do PELTs think about the challenges of being a teacher and how do these challenges impact their career decisions in Türkiye?
- What professional needs do PELTs have in Türkiye?

Method

Researchers use a case study to unveil something exists (Yin, 2009) with an in-depth examination of one or more persons, activities, events, or processes (Creswell, 2016). The main aim of a case study is understanding how the case works, what it means, and why it looks like it does within the context in which it functions (Hiebert et al., 2023). In line with the purpose of the current study, this research was designed as a qualitative case study.

Participants and Research Setting

This research study aims to investigate career decisions and professional needs of PELTs before they start school practicum since they mostly reconstruct their career plans during their training (Oruç, 2013). To this end, the current study was conducted at the end of their junior year just before they started school practicum. There were 51 junior PELTs in one of the teacher education programs at a university in Istanbul at the time of this study. While selecting participants, convenience sampling strategy was implemented to select cases that were the easiest to access in the research context (Patton, 2023). An invitation e-mail was sent to all PELTs with the necessary information of the research aims and procedure. 30 participants accepted participating in the study within two weeks. In this regard, the participants were 30 PELTs who were enrolled in elective career planning sessions at the teacher education program during 2022 Spring term. Eleven participants were male while nineteen participants were female. Their age range was 21-23.

Career planning sessions were offered to PELTs by the department on weekly basis to equip them with the necessary practices in designing career journeys. The sessions were designed weekly basis and aimed to guide PELTs for the following areas: using social media to develop a network and to follow recent updates in teaching, teacher mobility (The Erasmus+ Program) and study abroad programs (M.A. and Ph.D. opportunities), international language exams (TOEFL, IELTS), teaching certifications (CELTA, DELTA, and TESOL), teaching abroad (FLTA), teacher recruitment process in Türkiye, teaching English at tertiary level, being a rural teacher, writing a resume, and preparing for a job interview. After completing focus group interviews and gaining a general perspective on the issue, the second e-mail was sent to participants to invite them to take part in face-to-face semi-structured interviews. After waiting for two weeks, three participants were accepted to be interviewed to gain in-depth insights about the concepts extracted from focus group interviews. Participants' profile is provided below (please see Table 1).

Table 1.
Participants' Profile

Participant	Age	Gender
P1	21	Female
P2	21	Female
P3	23	Male

Data Collection Tools

In qualitative case studies, focus group and individual interviews are the main data collection tools (Yin, 2009). Semi-structured individual and focus group interviews were conducted to gather the data in the this study. In this study, the validity of the interview questions was ensured through a systematic process. Initially, all questions were developed based on the objectives of the study and a review of relevant

literature to ensure alignment with the research focus. To establish content validity, the questions were then examined by two independent experts who have extensive experience in qualitative research and teacher education programs. In order to employ focus group interviews, the participants were divided into five groups based on their availability in the same hour, which is considered as the ideal size (Krueger & Casey, 2008). All focus group interviews were conducted in three days in the last week of career planning sessions, and they lasted between 25 and 35 minutes. During focus group interviews, eight questions were asked to learn their opinions about their career goals, plans to pursue additional education, skills and training they need to make them better at teaching, ways to advance in their teaching career, being an English language teacher in Türkiye, rewards and challenges of teaching, and changes in their career plans after participating in career planning sessions at the teacher education program.

Semi-structured individual interviews facilitate empathy and tend to produce richer data (Cohen et al., 2018) and also provide opportunities for extensive follow-up responses after focus group interviews (Lambert, 2008). To this end, after completing focus group interviews, the second invitation e-mail was sent to participants to ask them to participate in semi-structured individual interviews. Three of the participants accepted to be interviewed. Preliminary data gathered from focus group interviews were read and reread several times before individual interviews to further probe details that participants have provided before. Interviews lasted between 10 and 15 minutes. Interview questions were asked to elaborate on the answers given during the focus group interviews. All interviews were audio-recorded after receiving participants' written consent.

Data Analysis

The steps suggested by Miles and Huberman (1994) and Yıldırım and Şimşek (2011) were followed to analyze the data of the study. Firstly, the researchers read transcripts of focus group and semi-structured individual interviews several times and wrote notes in the margins of transcripts for data reduction (Miles & Huberman, 1994). With this step, the mass of unconnected data was eliminated, and the most salient data was marked. After that, the data were grouped in accordance with the interview questions and research questions respectively. In this stage, the researchers reached the descriptive codes as the early labels of data with inferences made by the researchers (Yıldırım & Şimşek 2011). Then, researchers focused on how many times the same codes were used by the participants. This stage was followed to form categories by grouping codes in order to reduce the number of codes while analyzing the data (Creswell, 2016). In this study, there was 92% agreement between coders to ensure the reliability. All disagreements between coders were discussed to clarify the conflicts. Afterwards, the researchers grouped categories to generate the broader themes (Yıldırım & Şimşek, 2011). For instance, 'having desire to choose a different job' and 'planning to work in a different profession after graduation' were grouped into 'career shifts'.

Trustworthiness and Ethical Considerations

The strategies suggested by Lincoln and Guba (1985) were implemented in the current study. Firstly, triangulation was provided through using multiple data collection tools in this study. The relevant data was collected via two different data collection tools at different times. The other strategy used in this study is member checking. The participants were requested to read rough drafts of findings and asked to review findings for accuracy. Finally, the data was coded by two different researchers at different times to ensure the inter-coder reliability. The codes that the researchers agreed on were accepted while the codes that they did not agree on were changed until a consensus was provided. Also, some steps were taken into consideration to address the ethical implications. The research proposal was submitted to the social sciences scientific research ethics committee of the institution where the participants were studying. After receiving the approval from the committee, the participants were given the informed consent form including aim of the study, data collection procedures, potential risks, and benefits of the study. Finally, all participants were given numbers (P1, P2 and so on) to ensure their anonymity.

Findings

This section presents the findings derived from the analysis of focus group interviews and semi-structured individual interviews conducted with PELTs. The analysis revealed three overarching themes that reflect the participants' perspectives on their professional aspirations and career planning experiences: (1) Teaching in Türkiye: Difficulties and demands, (2) Choosing a different career path, and (3) Professional needs of PELTs.

Teaching in Türkiye: Difficulties and Demands

Of the 30 PELTs ten mentioned the challenges of being an EFL teacher in Türkiye. During focus group interviews (hereafter, FGI) and semi-structured individual interviews (hereafter, SSI), PELTs pointed out the current situation of being a teacher in Türkiye. According to them, lack of well-prepared teaching materials, low income, and non-teaching duties are the main challenges of pursuing teaching as a career. One of the participants, who has been working as a part-time etude teacher in one of the private schools in Istanbul, shared his own experiences about being a teacher and his career changes with the following words:

When I saw some bad situations like having no proper materials and getting very low income, it left me puzzled if I had chosen the wrong profession for me. In the private sector, teachers are not only teachers but also serve as a kind of worker. However, this course made me think of job alternatives. (P3, FGI)

During the individual semi-structured individual interview, P3 was asked one more time to explain what kind of job alternatives he was considering for himself. He said: "Actually, I do not want to teach in Türkiye neither in a state school nor in a private institution. I am considering teaching abroad after receiving certificates." (P3, SSI)

In line with the statement of P3, another participant highlighted the hardships of being a teacher in Türkiye. She stated that teaching at state schools is a kind of vicious circle for English language teachers that limits their professional growth. She said:

My career goals have been changed to include travelling and meeting with new people. As far as I know, teaching in a state school is very stable in Türkiye because you teach the same subject with the same books and methods every year. Especially, if you are an English language teacher, you must be open to new cultures and experiences. After being guided in career planning sessions, I understood what I do not want to do in the future. (P30, FGI)

One of the participants drew the attention to the fact that PELTs might be affected by the atmosphere of the country in which they teach while making long-term career plans. She said:

From now on, I can say that being a teacher is not easy in Türkiye because of the financial conditions and the upcoming student profile. I want to change this but changing something is not easy. My career plans did not change after career planning sessions because I had already made up my mind to quit teaching in Türkiye. (P18, FGI)

Two of the participants remarked that they were unsure about their career goals; however, they clearly stated what they do not want to do in the future. One of them shared his thoughts as follows: "I am not sure if this job is suitable for me. These sessions helped me think about alternatives." (P22, FGI). Likewise, it was stated by one of the participants that both private and state schools have drawbacks for teachers in Türkiye. She shared her concerns with the following words: "Private schools scares me because of high expectations of parents and administrators. On the other hand, state schools do not contribute to teachers' professional growth. I am really confused about my profession." (P1, FGI). During semi-structured individual interviews, P1 was asked to elaborate on the previous statement. She

mentioned that she began to consider working in a prestigious private school to sustain her professional development. She said:

Thanks to the sessions we had, I feel myself more ready for my future career because we learnt AP, IB, CELTA, FLTA, and much more. I also realized that the demanding nature of private schools keeps teachers updated with educational trends and practices. So, I am close to be a teacher in a private school (P1, SSI)

Choosing a Different Career Path

Career shifts

As the data revealed, 19 participants reported re-evaluating or changing their career plans after the career planning sessions, with a majority exploring opportunities abroad due to economic conditions and low salaries in Türkiye. These findings highlight the important role of external socio-economic factors in shaping career decisions among PELTs. Participants appeared to voice concerns about the limitations and challenges of pursuing a teaching career in the Turkish context, which pushed them to explore alternative pathways. For instance, P7 shared their pragmatic approach as to navigate these challenges by prioritizing teaching opportunities abroad as follows:

Türkiye is dealing with a hard economic situation nowadays and I think it is very normal to plan working abroad. My first choice will be teaching English abroad; however, if I cannot find a teaching position, I will try to enroll in a master's program to stay in a foreign country for a period time. (P7, FGI)

This statement shows the dual motivations of financial security and professional mobility, which are considered as more attainable outside Türkiye. During her individual interview, P2 stated, revealing that her focus remained on teaching abroad as a good option and her intention to achieve this by taking the TOEFL exam to meet international qualifications. In a similar vein, P2 expressed her concerns about the economic instability, which causes uncertainty about a sustainable career in teaching. She said:

I am planning to work in a different field when I feel ready and have enough courage. Türkiye's economic situation is a big factor. I want to feel hopeful about my financial future. I believe that I need to consider other options. (P2, FGI)

During her individual interview, P2 stated, revealing that her focus remained on teaching abroad as a good option and her intention to achieve this by taking the TOEFL exam to meet international qualifications. She added, "I do not believe that I will live a good life if I teach in Türkiye. First, I will take the TOEFL exam to study abroad then try to find a teaching position." (P2, SSI).

The career aspirations of P7 and P2 demonstrate a broader trend among participants to relate their professional ambitions with global mobility. These findings show that economic difficulties in Türkiye might act as a deterrent to pursuing a traditional teaching career and also inspire participants to seek for international opportunities to achieve career growth and financial stability.

Certifications and education

In a similar vein, one of the participants started to plan his post-graduate education after attending to career planning sessions. Initially, his career goal was to apply for a master's program in Türkiye for personal development, but after learning about the opportunities abroad, his priorities shifted. As he stated:

Before career planning sessions, my aim was applying for a master's program in Türkiye for my personal development. I did not plan to study abroad because I did not know the requirements, what I mean is I did not know where to start. Now, I am planning to study abroad, and the master's program is not very important for me. I will do this to look for a job. (P10, FGI).

This shift indicates that the participant's motivation was not initially academic but instead driven by the desire for life and career opportunities in a foreign country, which shows the critical impact of the career planning sessions in broadening his perspective on education and professional development. In addition, during focus group interviews, eight students discussed their intentions to take CELTA (Certificate in Teaching English to Speakers of Other Languages) as a pathway to teaching English abroad, particularly in European countries. For these participants, the motivation behind CELTA was predominantly extrinsic, driven by the expectation of higher salaries and the ability to travel. As shown in the data, most of them were introduced to CELTA for the first time through the career planning sessions, which informed them about the potential international teaching opportunities. To this end, after being informed about teaching English abroad opportunities, PELTs experienced a shift in their career plans. Several participants reconsidered their options in light of more favorable conditions abroad. Two participants, P22 and P15, shared their revised career goals:

At the beginning of the semester, I was planning to teach in a public school in Türkiye because I thought that I have no other option. After attending these sessions, I have changed my career plans. Now, I am planning to take CELTA to teach abroad because I want to earn more to travel and improve myself. (P22, FGI)

Similarly, P15, who initially considered academia as the most viable career path, stated how CELTA emerged as a "lifesaver" in his professional journey. He added:

I was thinking about to be an academician at the beginning of the semester because it was the best option for me after graduation. I have never planned to be a teacher. I cannot imagine myself teaching English in a public school because it is too stable and low-paid in Türkiye. So, CELTA became a lifesaver for me. (P15, FGI)

These findings show how the career planning sessions exposed participants to certification programs such as CELTA and emphasized the role of extrinsic motivation in reshaping their career goals.

Professional Needs of PELTs

Global exposure and cultural exchange

14 participants emphasized the importance of attending to short-term study abroad programs as a key element of their professional development. Many of them mentioned that they first learned about the Fulbright Foreign Language Teaching Assistant (FLTA) program through the career planning sessions. The FLTA program was regarded as a valuable opportunity for travel and cultural exchange, especially in the United States. One participant said:

As an English language teacher, it is of vital importance to spend some time in an English-speaking country because we teach language and culture at the same time. Unfortunately, it is financially impossible for me to go to the USA; that's why, FLTA program caught my attention. (FGI, P2)

The importance of adopting a global perspective in language teaching was also highlighted during the semi-structured interviews with P1 and P2. Both participants emphasized the impact of cultural awareness and respect in the classroom, revealing the importance of bridging diverse cultures in language education. As P2 noted:

The topics [we have covered this semester] provided me a global perspective for my professional career. I realized what I need to address multiculturalism. I do not plan to teach abroad; however, I want to be a role model for my students here. I am open to short-term programs to learn how I can change my students' world. (P1, SSI)

P2 echoed this sentiment, stating:

Teaching in a foreign country provides teachers with new cultures and teaching skills. This can help them develop a global understanding and improves their skills to teach English to a diverse group of students. That's why, I am interested in international programs and certificates because it will make me outstand in the job market. (P2, SSI)

Building on this, one participants drew attention to the need of cultural exchange for language professionals, describing it as a vital part of professional development that involves the sharing of ideas, traditions, and knoweldge. He shared:

I love meeting with new people, and I know that our job is very suitable for this. I perceive myself as a global citizen because I respect all people and their way of life. I do not want to limit myself as a teacher, I want to travel and use English to communicate. Before these sessions, I did not know much about how to go abroad as a teacher. Now, I am planning to apply for the FLTA program. (FGI, P19)

Participants noted the FLTA program was not only beneficial for cultural exchange but also helped improve teaching skills and increase English language proficiency.

Professional aspirations

Participants stressed that the FLTA program as a valuable opporuntunity for professional growth, offering not only the change for travel and cultural exchange but also important benefits in enhancing teaching skills and increasing proficiency in English. One participant shared:

After attending these sessions, I realized that being a teacher is more than graduating. My previous plan was being a teacher in a state school right after my graduation. However, I have always been aware of the lack of opportunities to improve myself in a state school. So, I will consider living in a foreign country because communicating in English will be compulsory for me. FLTA caught my attention because it is very prestigious and also beneficial to improve my teaching skills. (FGI, P13)

This statement reflect the participants' belief that, in the context of Türkiye's educational system, opportunities like FLTA are viewed as crucial for developing the global perspective, cultural exchange, and professional skills required in an international teaching environment. Most participants viewed such programs as a necessary step in achieving their career aspirations, which they felt could not be fully realized within the constraints of the local educational framework.

Overall, the findings reveal that the economic climate in Türkiye has a significant role in (re-)shaping the career decisions of PELTs, with many turning to international opportunities or contemplating alternative career paths altogether. As PELTs perceived the current education system as offering limited opportunities for professional growth, participants were more likely to express a strong desire for dynamic, innovative, and culturally enriching environments abroad. Career planning sessions emerged as critical moments in this process, providing participants with valuable insights into global certifications such as CELTA and programs such as FLTA.

Discussion, Conclusion, and Suggestions

The findings of this study reveal several interconnected themes, revealing the challenges, career shifts and professional aspirations of PELTs in Türkiye, driven largely by the socio-economic conditions and limited professional growth opportunities within the local educational system. This section will explore these themes, linking them to broader implications for language teaching in Türkiye and internationally. This study aimed to investigate the career decisions and career development aspirations of PELTs in Türkiye with a focus on the anticipated challenges, the desired development and support opportunities available for professional engagement and growth, and the perceived gaps between the expectations and realities. The analysis revealed that the complex difficulties experienced by PELTs in the country.

The challenges faced by PELTs in Türkiye are multifaceted, involving economic instability, limited professional development opportunities, and the pressures of non-teaching duties. The economic constraints are particularly significant, as most participants expressed frustration over the low income, lack of proper teaching materials, and non-teaching responsibilities, which hinder their professional development. One of the major challenges expressed by the participants is the lack of well-prepared teaching materials, which not only influences the quality of instruction they offer but also adds to their workload because of spending significant time and effort to create materials themselves. The absence of sufficient resources could demotivate teachers, causing them to question the feasibility of continuing in the teaching profession (Admiraal et al., 2023; Valizadeh, 2021). Another important challenge shared by the participants is the issue of low income. L2 teaching, particularly in the Turkish context, is primarily considered as a financially unrewarding choice of career. This issue influences the teachers' quality of life in addition to their professional motivation and job satisfaction (Karakış, 2021). This economic burden may be challenging for young, future teachers who are beginning their careers (Hoque et al., 2023). Given the participants' frustration with non-teaching duties, involving administrative tasks or extracurricular responsibilities, it is noteworthy to suggest that this imbalance in teacher workload could lead to burnout and ultimately make them dissatisfied and disillusioned with teaching (Solomons & Abrams, 2023).

The career planning sessions played a pivotal role in (re-)shaping PELTs' career aspirations, which 19 participants revising or re-evaluating their career goals after engaging in the sessions. Many reported an increased interest in teaching abroad, triggered by both financial motivations and the desire for professional mobility. Furthermore, the participants' perceived limitations in professional development, specifically at state schools highlight the need for providing extensive opportunities for career advancement or professional growth. Otherwise, the lack of professional development prospects might be discouraging for PELTs who are looking for a fulfilling and evolving career path (Akkaş & Çöker, 2016; Bursalı & Mısır, 2021). Therefore, there is a need for efforts to improve these areas, such as income, workload balance, instructional materials, and professional development opportunities, to contribute to the overall quality of L2 education in the country, which may, in turn, have positive impacts on the teaching motivation and satisfaction of language teachers.

The second major challenge expressed by the participants is closely related to the important impact of external factors, such as financial situation in Türkiye, on the career decisions of PELTs. The uncertainty, resulting from the current economic situation, seemed to prompt PELTs to consider alternative career paths and motivate them about the perceived contributions of financial security and career advancement in other countries. Participants such as P7 and P2 indicated that the economic situation in Türkiye and the instability of the local teaching market led them to explore opportunities outside the country, such as teaching English abroad or pursuing postgraduate education. These findings align with prior studies, which reveal that economic factors may influence individuals' career decisions (Chaban et al., 2023). Additionally, as teaching English in a foreign context was viewed as an exciting opportunity to broaden their horizons, the participants particularly emphasized the prospects of working in a different education system to have new perspectives on teaching and learning (Oldac, 2023).

These findings suggest that the Turkish educational system may be pushing PELTs to seek career alternatives due to the lack of sustainable professional development opportunities. This shift towards

international opportunities is not only about financial gain but also about seeking dynamic, culturally enriching settings where teachers can develop their teaching skills and experience new teaching methods.

The introduction of international certification programs, involving CELTA and the FLTA, emerged as significant factors influencing participants' career shifts. As several participants noted, these programs offered a pathway to teaching abroad as well as providing the necessary skills to compete in a global job market. For instance, P22 and P15, who had initially planned to teach in state schools in Türkiye, shifted their focus to taking CELTA to secure positions abroad. This transition reveals how career planning sessions provided participants with new tools to reconsider their professional trajectory. The participants attributed importance to the ongoing professional development to be updated with the current trends and different teaching methodologies and acquiring global perspectives in the teaching practice. The participants' beliefs about short-term study-abroad programs, involving the FLTA program, as valuable opportunities for professional development are consistent with the existing research (Bursalı & Mısırlı, 2021; Mutlu & Ortaçtepe, 2016; Peker, 2020). These international programs are crucial to foster teachers' teaching skills, help them become culturally competent educators in multicultural settings, and contribute to their English proficiency (Ku, 2023). Additionally, participants such as P10 indicated that career planning sessions helped them rethink their postgraduate education choices, motivating them to consider studying abroad to enhance their career prospects. This change shows the broader trend of PELTs seeking international qualifications to better position themselves in the global teaching workforce.

Most participants highlighted the role of global exposure and cultural exchange in their professional development. Programs like FLTA were particularly viewed as opportunities for gaining valuable teaching experience while also developing cultural awareness. Many participants expressed a desire to teach in English-speaking countries to gain firsthand experience with diverse cultures, which they considered vital for enhancing their teaching practices in multicultural classrooms. As one participant mentioned, "I want to be a role model for my students here," emphasizing the broader impact of global experiences on teaching strategies. Moreover, the cultural exchange aspect of international teaching programs was seen as essential for both personal and professional growth. Participants felt that such experiences would not only improve their teaching skills but also increase their proficiency in English, further contributing to their development as educators.

Although the small number of participants in this study may limit the generalizability of the findings to other settings, this study has several implications for policy and practice for L2 (teacher) education in Türkiye. The financial challenges faced by PELTs reflect broader systemic issues in teacher education, as supported by studies indicating that economic constraints are a critical barrier to entering and remaining in the teaching profession (Darling-Hammond, 2017). Offering economic support or incentives for prospective educators in L2 teaching might alleviate financial burdens and encourage individuals to pursue L2 teaching as a sustainable career path, as showed in successful examples from countries with strong teacher support systems (OECD, 2019).

There is a need for institutions and policymakers to address the financial challenges encountered by PELTs. Offering economic support or incentives for future educators in L2 teaching may alleviate several financial burdens and encourage individuals to enter the L2 teaching profession. In addition, through carefully designed professional development initiatives that may involve partnerships with international institutions to provide exchange programs or short-term teaching opportunities, the outcomes of such efforts can be optimized in terms of linguistic and intercultural gains as well as professional growth. In addition, professional development initiatives, particularly those involving partnerships with international institutions, have been shown to enhance linguistic proficiency, intercultural competence, and teaching skills (Larsen-Freeman, 2015). Lastly, the desire expressed by the participants for L2 teaching in a foreign context reveals a need for programs that foster international collaboration and inter-cultural exchange among (prospective) language teachers. The expressed desire by participants for L2 teaching in a foreign context aligns with findings from studies highlighting the

value of fostering international collaboration and intercultural exchanges among teachers (Borg, 2015). These efforts can enable to create a more diverse and culturally aware and responsive teaching workforce, eventually, contributing to L2 teaching in Türkiye.

This study provides valuable insights into the the career trajectories, aspirations, and challenges faced by PELTs in Türkiye, emphasizing the need for systemic changes in the educational context. The findings of this study highlights that financial stability, lack of professional development opportunities, and heavy non-teaching responsibilities might lead to important barriers, pushing most PELTs to reconsider their long-term engagement in the teaching profession. The growing tendency towards international career pathways indicates a strong desire for professional mobility, financial stability, and global teaching experiences. This trend reveals PELTs do not only seek for economic improvement but also diverse teaching methodologies, global perspectives, and intercultural competence.

Despite the small size of participants, this study makes a significant contribution to the growing body of literature on career decisions and professional aspirations in L2 teaching that has received limited attention by exploring PELTs' desires for their professional engagement and career development. Further research may investigate how short-term study abroad programs, such as the FLTA, contributes to teachers' professional development, intercultural competence, linguistic skills, views on teaching and learning as well as job satisfaction. Research can also focus on examining ways of promoting professional development opportunities for language teachers, particularly in underfunded state school settings (British Council, 2018).

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Teachers' Views on the Use of Artificial Intelligence in the Education Process

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Abstract

This study aims to reveal teachers' thoughts on AI. Thus, from the teacher's perspective, it is to expose the positive and negative effects of AI technology on students and the educational process and to create a source for predicting the problems that may be encountered during its integration into the education system. Phenomenological design, one of the qualitative research methods, was used. The participant group of the study consisted of eight teachers from different branches formed by the maximum variation, one of the purposeful sampling types. In the interview conducted with the focus group interview, the questions in the semi-structured interview form prepared by taking expert opinions were asked to the participants, and the data of the research were collected. The collected data were analyzed with descriptive analysis and coding was executed. The research findings indicate that AI is perceived differently by teachers, that its applications vary, that technology presents both advantages and downsides and that there are individual and societal concerns that warrant attention. Teachers generally exhibit amazing, helpful, useful, and favorable attitudes toward the increasingly widespread usage of AI, demonstrating a high level of awareness of the technology. It is recommended to conduct applied research on the use of AI in education to clarify its positive and negative aspects.

Keywords: Artificial intelligence, Education, Teacher's view, Phenomenology.

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Introduction

For many years, scientists have been curious about the human brain and its functioning has been the subject of research. With the invention of computer systems, it was discovered that the abilities related to human intelligence can be realized by machines. This discovery led to the idea of developing machines that can learn, think, and make decisions (Çetin & Aktaş, 2021). Attempts have been made to imitate the functioning of the human brain and to create similar structures. Research has led to significant progress in this field and many fields of study, concepts, and topics have emerged. AI, one of these concepts, first emerged when robots were able to feel or think (Kazu & Özdemir, 2009) and has recently developed rapidly and has become one of the most important tools of today. AI was first mentioned conceptually in a letter written by John McCarthy, Marvin L. Minsky, Nathaniel Rochester, and Claude E. Shannon at the Dortmund Conference in 1956, in which they proposed to study AI with a team of 10 people for 2 months (McCarthy et al., 2006). For this reason, John McCarthy is recognized as the inventor of the concept of AI (Alpaydın, 2011; Arslan, 2020).

AI is defined as mechanical intelligence that makes sense of and interprets the data it receives from outside the existing system, learns from these data, and can use the data and learning it obtains to serve specific purposes and tasks (Haenlein & Kaplan, 2019). AI, which is essentially based on imitating the human brain and examining how humans think and how they function in solving problems, is a tool that renews and improves itself thanks to the data it collects in this process. In its simplest definition, it is the intelligence created by machines (Alanoğlu & Karabatak, 2020). AI, which can work much faster than the human brain when it comes to the rapid processing of many complex tasks within a certain system at the same time (Teng, 2019), is used directly or indirectly in many areas of life, such as defense industry, health, finance, security, and education (Komalavalli et al., 2020; Popenici & Kerr, 2017). The number of AI tools that require human-specific metacognitive thinking (perception, thinking, learning, inference, problem-solving, suggestion, communication, and decision-making), such as smart assistants, recommendation engines, or chatbots, which are already in daily life, is increasing day by day (Alanoğlu & Karabatak, 2020; İncemen & Öztürk, 2024; Taşçı & Çelebi, 2020). While AI technologies serve people on almost every platform through various devices and applications, they have become an indispensable part of many sectors, from education to health, the economy to transportation, and communication to shopping, by replacing traditional tools (Banaz & Demirel, 2024). Autonomous vehicles, smart home technologies, or smartphone applications are examples of the use of these technologies in various fields.

AI, having emerged as a prominent force due to its distinguishing capabilities, has been advanced through research and today enhances human existence with attributes such as perception, self-learning, decision-making, and inference (İçöz & İçöz, 2024). It is anticipated that in the future, AI will enhance its functionality, influence human lives, and assume an active role comparable to that of humans through widespread integration into daily activities (Çetin & Aktaş, 2021). AI technology, which is swiftly becoming integral to daily life, enhances its role and functionality within educational services (Aruğaslan & Çivril, 2021; Chassignol et al., 2018; Çolak Yazıcı & Erkoç, 2023; Popenici & Kerr, 2017; Verma, 2018). It is posited that learning processes will become more prevalent and efficient without temporal and spatial constraints, offering personalized educational assistance (Akyel & Tur, 2024; Athanasios & Ioannidou, 2012; Ünsal, 2024). Moreover, functions such as the early identification of learning disabilities, delivering effective instruction for students with special needs, and offering educational opportunities for those facing attendance challenges due to illness are also noted (Altun, 2024; İşler & Kılıç, 2021). Besides enhancing learning and addressing deficiencies, AI is employed in various domains, including entrance and exit monitoring, instruction and assessment, attendance tracking, administrative tasks, providing feedback to educators regarding classroom management, and streamlining school administration (Arslan, 2020). The uses of AI in education are always broadening and evolving. This alteration will surely transform the future of education and the services offered in this domain (Kutlucan & Seferoğlu, 2024). Therefore, in addition to students, lecturers, teachers, and pre-service teachers should adapt to the rapid development of AI technologies by gaining awareness (Uzun et al., 2021; Yeşilyurt et al., 2024).

Technologies used in education are diversifying and developing day by day. AI applications are one of the innovative uses of technology in education. AI in education is rapidly becoming widespread as an

innovation with the potential to personalize learning processes, enrich teaching methods and reduce administrative burdens (Holmes & Porayska-Pomsta 2023). In particular, the fact that AI provides individualized feedback by analyzing data on students' learning processes and allows teachers to assume a more strategic role increases the importance of this technology. In recent years, the rapid increase in the use of AI technologies in education has brought about various debates. While AI provides positive effects such as increasing efficiency in education and personalizing learning processes, it also raises negative issues such as ethics, privacy and addiction (Kutlucan & Seferoğlu, 2024). When the studies conducted in this field are examined, it is seen that AI is mainly focused on learning and students, such as how AI can improve educational processes, how it can increase student success, how it can make learning processes more efficient and how it can make progress in this direction (Akdeniz & Özdiñ, 2021; Altun, 2024; Çetin & Aktaş, 2021; İncemen & Öztürk, 2024; Yu et al., 2021; Zileli, 2023). However, it is seen that the studies addressing teachers' views on AI are limited in the literature (Bayraktar et. al., 2023; Küçükkara et. al., 2024; Özer et. al., 2023). This situation constitutes an important obstacle in the integration of AI into the education system and reveals the need for comprehensive studies on teachers' perceptions.

Teachers are the primary actors who know the dynamics of the classroom environment best and can closely observe the individual needs of students. Therefore, teacher opinions play a critical role in the effective and efficient implementation of AI applications in education. The extent to which the potential benefits offered by AI, such as personalized feedback and strategic instructional support, can be adapted to classroom practices depends largely on how teachers perceive, evaluate and use this technology. Despite the arguments that AI can improve educational processes, teachers' concerns about ethics, privacy, and addiction during the adoption process can pose significant barriers to the integration of technology into the educational environment (Will & Mishra, 2021). Teachers' positive or negative views of AI can directly affect the use of these technologies in the classroom and shape students' learning experiences. While a positive perception supports the adoption of innovative practices and the effective use of technology in the educational process, negative views can slow down or limit this process. Therefore, exploring teachers' views will allow for a better understanding of the role and potential risks of AI in education. Thus, it will provide important contributions in determining strategies to support the integration of AI into the education system, identifying potential risks and problems early, and developing solutions.

In this study, it is aimed to reveal teachers' thoughts on AI. Thus, the positive and negative effects of AI technology on teachers and the educational process will be revealed. In addition, the results of the research will be a source for predicting the problems that may be encountered during the integration of AI technology into the education system. In line with this purpose, answers to the following questions were sought:

1. What are teachers' views on AI and AI applications?
2. What are the opinions of teachers on the use of AI in the education process?
3. What are teachers' views on the advantages and disadvantages of using AI?
4. What are the opinions of teachers about the risks that AI may pose?

Literature Review

While technological developments are radically transforming education systems, AI is at the center of this transformation. AI offers many potential benefits, such as personalizing student learning processes, reducing the workload of teachers, and enriching educational materials (İşler & Kılıç, 2021). In this direction, studies on the use of AI in education are increasing. In the historical process, student modeling and information tracking have an important place among the uses of AI in education. Corbett and Anderson (1995) established the foundations of individualized learning in ITSs by modeling students' procedural knowledge acquisition processes; Koedinger et al. (1997) supported the applicability of ITSs in school environments with experimental data. The ASSISTments ecosystem developed by Heffernan and Heffernan (2014) has brought a new dimension to data-driven research in AI-based educational applications by encouraging collaboration between teachers and researchers. Altundal (2024) comprehensively examined the history, definitions, application examples, and potential areas of use of

AI in many fields, especially in education. In particular, while rapidly developing AI applications lead to significant changes in the roles of students and teachers in foreign language teaching, Yiğit (2024) drew attention to the necessity of individualizing educational processes and improving teachers' use of technology and stated that AI-based mobile applications are still at an early stage. The systematic review by Akdeniz and Özdiñ (2021) reveals that these studies have gained momentum in recent years and are mostly carried out at the university level. Coşkun and Gülleroğlu (2021) stated that the use of AI in education gained momentum after the Second World War and became widespread rapidly in the 21st century. In future perspectives, it is predicted that AI may change the role of the teaching profession. Çetin and Aktaş (2021) evaluated AI-supported teaching scenarios and discussed how these scenarios can transform the guidance role of teachers, while Küçükali and Coşkun (2021) analyzed the impact of digitalization on educational administration and emphasized that AI can create decision support systems for school administrators. In terms of educational data mining, Romero and Ventura (2007) highlighted the importance of data-driven approaches in optimizing learning processes; Chen et al. (2020) examined the versatile use of AI in education through systematic reviews, highlighted different application areas and potential benefits, and showed that automated and adaptive assessment systems can produce reliable and effective results. In addition to these studies, Keser et al. (2024) analyzed 4935 studies indexed in the Web of Science database and showed that most of the academic production on AI in education has occurred in the last five years. Historical and current studies reveal that this technology has led to revolutionary changes in educational practices and management. In the future, it is predicted that the increasing use of AI will reshape teaching methods and educational administration.

The applicability of AI in education attracts attention with the innovative solutions it brings. Today, the use of AI in education covers many subfields such as individualized learning, intelligent tutoring systems, educational data mining, and learning analytics. In this context, VanLehn (2011) revealed the potential of AI-supported applications on learning outcomes with a meta-analysis comparing the effectiveness of human teaching and intelligent tutoring systems, while Zawacki-Richter, Marín, Bond, and Gouverneur (2019) systematically examined AI applications in higher education, revealing how technological developments transform educational processes and the change in the role of educators. Savaş (2021) examines the innovative applications of AI in education and discusses how technological integration can increase student achievement. Arslan's (2020) study made significant contributions with the ability of AI to personalize learning processes, make intelligent predictions, and adapt to changing conditions. The use of AI-based tools in mathematics teaching stands out with its contributions to problem solving, analytical thinking, and personalized learning processes (Tutak, 2024). Students' interaction, motivation, and learning behaviors are also important factors in the evaluation of AI applications. While Papamitsiou and Economides (2014) systematically reviewed learning analytics and educational data mining studies, Baker et al. (2009) presented general models developed to detect inefficient learning behaviors of students. The importance of personalized instruction and emotional engagement in education is compared by Conati and Kardan (2013) with strategies that support personalized learning through student modeling. D'Mello and Graesser (2015) evaluated emotion-sensing learning technologies and emphasized the importance of integrating emotional factors into learning processes. Chi et al. (2001) discussed how these approaches can be reflected in the design of AI-based systems based on human teaching experiences. On the other hand, teachers' perceptions of AI also have an important place in research. In a qualitative study, Çetin and Baklavacı (2024) emphasized that teachers are willing to use AI but need strategic planning, while Ağmaz and Ergulec (2024) revealed in their metaphor analysis that pre-service teachers generally see AI as a "guide" or "supportive" tool. Moreover, while AI-based instructional materials and intelligent instructional systems stand out, especially in fields such as mathematics and science, the use of AI in in-service training programs accelerates teachers' adaptation to technology and increases their pedagogical competencies (Nayiroğlu and Tutak, 2024; Karbuz and Aydınli, 2024). On the other hand, the innovations it brings to measurement and evaluation processes are some of the most remarkable aspects of AI in education. Çavuş (2024) states that AI-based assessment tools reduce the difficulties faced by teachers and can analyze student performance more objectively, while Aktay et al. (2023) examined students' perceptions of AI tools such as ChatGPT and revealed the supportive effects of these technologies on the learning process. Another important use of AI is the production of visual materials. Aktay (2022) investigated the use of images generated by AI as course materials and stated that these materials make learning more

effective. In addition, Tekin (2023) systematically analyzed educational research in Turkey and found that teachers are willing to use AI-based tools but do not receive adequate guidance and infrastructure support.

AI has the potential to bring about major changes in many areas beyond education. The increasing number of studies in the literature on how AI can be used in education raises expectations for this technology. However, the ethical limitations and potential risks of using AI in education should not be ignored. Öksüz Gül (2024) draws attention to these risks for academics in the field of education. In general, the reviewed studies show the potential of AI-based education systems to improve student performance, optimize individualized learning, and enhance data-driven decision-making. These different studies in the literature provide important insights into how AI applications in education can be developed both technologically and pedagogically.

Method

Research Design

This study employed a phenomenological design, a qualitative research method, to investigate teachers' perspectives on the integration of AI in the educational process. The phenomenological design emphasizes the meanings individuals construct on a certain event based on their life experiences (Creswell, 2018; Edmonds & Kennedy, 2017; Patton, 2018; Tekindal, 2021). Phenomenological investigations concentrate on domains where our understanding is limited and lacks depth (Ceylan Çapar & Ceylan, 2022; Yıldırım & Şimşek, 2021). This strategy is seen more appropriate for studies aimed at elucidating how individuals comprehend the things they encounter and interpreting their meanings (Merriam, 2018). This study aimed to elucidate the interpretations generated by educators on the phenomena of AI and its impact on educational processes. Consequently, a phenomenological design, deemed suitable for its essence, was employed in the execution of the investigation.

Participant Group

In this study, the maximum variation, one of the purposeful sampling types, was used to determine the participants. With this approach, focus group interviews were conducted with eight teachers working in public schools in the 2023-2024 academic year. Maximum variation sampling aims to increase the variables of the participants to be included in the research as much as possible (Özmen & Karamustafaoğlu, 2023). In this relatively small sample, the similar and common aspects of the maximum variety of participants who can be parties to the research are tried to be revealed (Yıldırım & Şimşek, 2021).

Factors such as instructors' discipline, gender, seniority, age, institution level, and educational attainment were considered in selecting participants for the study to ensure diversity. Furthermore, to find applicants with a strong understanding of AI, efforts were made to pick participants who utilize any AI application, get training, and remain informed. The identities of the participants were anonymized and assigned numerical designations. Table 1 presents the participants' personal information.

Table 1.

Personal Information on Participants

Participant	Gender	Age	Discipline	Institution Level	Year	Education Attainment
P1	Male	30	English	Primary school	6	Bachelor's
P2	Female	27	Classroom Teacher	Primary school	4	Bachelor's
P3	Male	33	Science	Middle school	12	Bachelor's
P4	Male	45	Geography	High school	16	Master's
P5	Female	31	Visual Arts	Middle school	8	Bachelor's
P6	Male	32	Literature	High school	10	Master's
P7	Male	29	Guidance	Middle school	7	Bachelor's
P8	Female	34	Classroom Teacher	Primary school	13	Master's

Table 1 indicates that the study comprised three female and five male participants, based on the gender variable. The participants were allocated based on their respective branches: One English teacher, two classroom teachers, one science teacher, one geography teacher, one visual arts teacher, one literature

teacher, and one guidance counselor. The professors' ages range from 27 to 45 years, and their professional experience spans from 4 to 16 years. According to the level of the educational institution they work in, 3 teachers work in primary school, 3 teachers work in middle school and 2 teachers work in high school. Regarding educational qualifications, three teachers possess a master's degree, while five hold a bachelor's degree.

Data Collection Tools

The semi-structured interview was used as a data collection tool. Semi-structured interviews enable collecting answers through pre-prepared questions to obtain in-depth information without directing the participant (Büyüköztürk et al., 2018). In semi-structured interviews, questions are prepared in advance, but questions can be added or removed during the interview, or the order of questions can be changed according to the situation. This feature provides flexibility to the researcher to obtain detailed information by the purpose of the research (Akman Dömbekçi & Erişen, 2022). Within the scope of the research, a literature review was conducted first. Then, interview questions were prepared in the light of the information obtained and the opinions of three academicians who are experts in the preparation of the interview form were taken. The clarity, comprehensibility and scope of the questions were evaluated and the order and number of questions were changed within the framework of expert opinions. The final version of the interview form included nine questions. In addition to the interview questions, a 6-question "Personal Information Form" was created to determine the personal information of the participants. Information on gender, age, years of service, graduated branch, institution level, and education level of the teachers was collected through the form.

Data Collection Process

Data were collected through focus group interviews. A focus group is a technique of obtaining multidimensional and detailed information and generating ideas about the interests, experiences, thoughts, feelings, perceptions, and attitudes of the participants by utilizing group dynamics (Çokluk et al., 2011), which is carried out with 4-12 participants with several similar characteristics and a meeting chair (Gülcan, 2021). In the study, data were collected through focus group interviews with a group of eight teachers.

A focus group interview was preferred as it is possible to obtain richer answers than individual interviews thanks to group dynamics. Among the candidates reached through the personal information form, eight participants who were willing to voluntarily participate in the research, who had experienced at least three AI applications, and who were interested and experienced in AI were selected. In focus group interviews, the number of participants was kept to a minimum as it would be difficult to conduct the interview effectively. Table 2 presents the participants' AI experiences.

Table 2.

Participants' Experiences with AI

Participant No	AI Experience
P1	Preparing personalized feedback to students with AI.
P2	Measurement and evaluation with AI.
P3	Creating video content with AI.
P4	Animating the visuals drawn with AI in 3D.
P5	Opening an exhibition with images created with AI.
P6	Writing stories with AI.
P7	Analyzing aggregated data with AI.
P8	Making lesson planning with AI.

Table 2 indicates the teachers in the participant group used AI tools for purposes such as giving personal feedback, making assessment and evaluation, preparing videos and visuals, writing texts, data analysis and lesson planning according to their interests and needs. The interview with participants with AI experience was conducted through an online meeting platform. The researcher provided the participants with the necessary information for the meeting to be held on the specified date and time. The participants were welcomed and taken to the online meeting room. During the interview, care was taken to ensure that the names of the participants were written correctly to avoid addressing problems. The recording

was started by stating that the interview would be recorded. The purpose and scope of the research were explained and voluntary consent was obtained from the participants. Pre-prepared questions were directed to the participants and answers were obtained. Necessary explanations were made on incomprehensible issues. No positive or negative feedback was given to the participants' answers. At the end of the interview, the participants were thanked by reminding them that they would be contacted again to obtain participant confirmation when their statements in the interview were prepared in writing. The interview lasted one hour and forty-eight minutes.

Data Analysis

The data were analyzed using the descriptive analysis. This analysis aims to interpret and reach a conclusion by organizing the findings obtained from the data collected through techniques such as documents, interviews, and observations into topics or themes (Yıldırım & Şimşek, 2021). The interview conducted for the research was recorded. The statements in this interview recording were then transcribed. Coding was performed based on the research questions. In this study, the research questions were addressed as themes. The Maxqda program was used to analyze the data, and the findings were presented in figures.

Validity and Reliability

The two most important criteria used to ensure the credibility of research results are validity and reliability. In the study, internal validity was ensured through credibility, internal reliability through consistency, external validity through transferability and external reliability through verifiability (Güler et al., 2015; Yıldırım & Şimşek, 2021). Table 3 presents the measures taken to ensure the validity and reliability of the study.

Table 3.

Validity and Reliability Measures

Validity	Internal Validity	Obtaining expert opinions
		Participant confirmation
		Presenting findings with direct quotations
	External Validity	Giving and explaining the stages of the research process
		Explanation of the data analysis process
		Announcement of participant selection
Reliability	Internal Reliability	Preventing data loss by recording
		Providing direct quotations
		Consensus calculation
	External Reliability	Data retention
		Appropriate discussion of data

The semi-structured interview form used in the research was organized by taking expert opinions. The questions were asked similarly to the participants. Data loss was prevented by recording the interview. After the interview, the participants were asked to confirm their statements in writing. The participants did not want to change their statements. The research process and how the participants were selected were explained in detail. To enhance the validity and reliability of the research, select statements from consulted participants were directly quoted and incorporated into the findings. The gathered opinions were encoded and displayed in a manner that preserved the anonymity of the participants. The results were presented devoid of generalization or interpretation, allowing the reader to draw comparisons. The themes and codes obtained as a result of the analysis were presented to two experts to examine whether they were organized effectively. Necessary arrangements were made in line with the suggestions received. For the themes and codes determined by the researcher and experts, the issues of “consensus” and “disagreement” were discussed and necessary arrangements were made. Miles and Huberman's (1994) formula were used for the reliability calculation [$\text{Reliability} = \text{Consensus} / (\text{Consensus} + \text{Disagreement})$] and the result was calculated as .89. According to Miles and Huberman, a reliability calculation of .70 and above indicates that the study is reliable.

Findings

In this section, firstly, the word cloud obtained from the participant views is given, and then the themes and codes created in line with the research problems are supported by the participant expressions and shown in figures. A word cloud was created with the word frequency analysis method using participant opinions. While creating the word cloud, prepositions, conjunctions, etc. were excluded. The generated word cloud is presented in Figure 1.

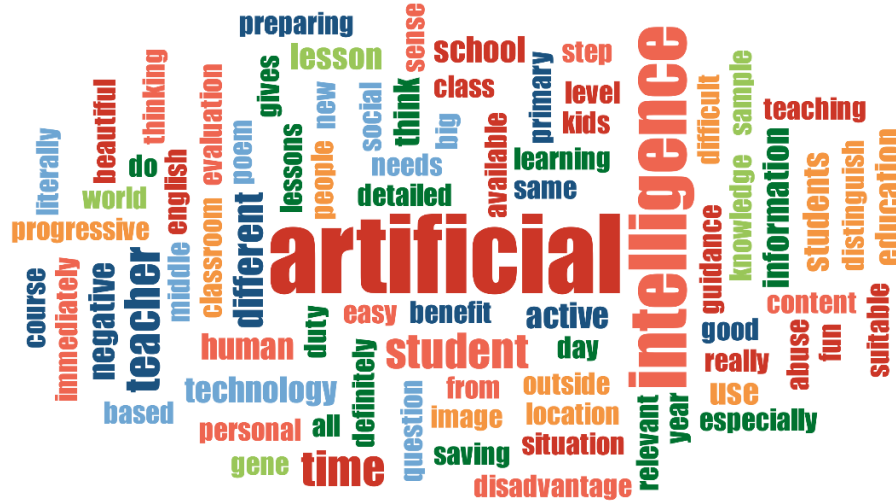


Figure 1. Word Cloud of Participant Views

Figure 1 shows that the participants mostly used words such as "artificial, intelligence, think, time, information, negative, active, human, student, teacher, lesson, different".

What are teachers' views on AI and AI applications?

The code model showing teachers' views on AI and AI applications is presented in Figure 2.

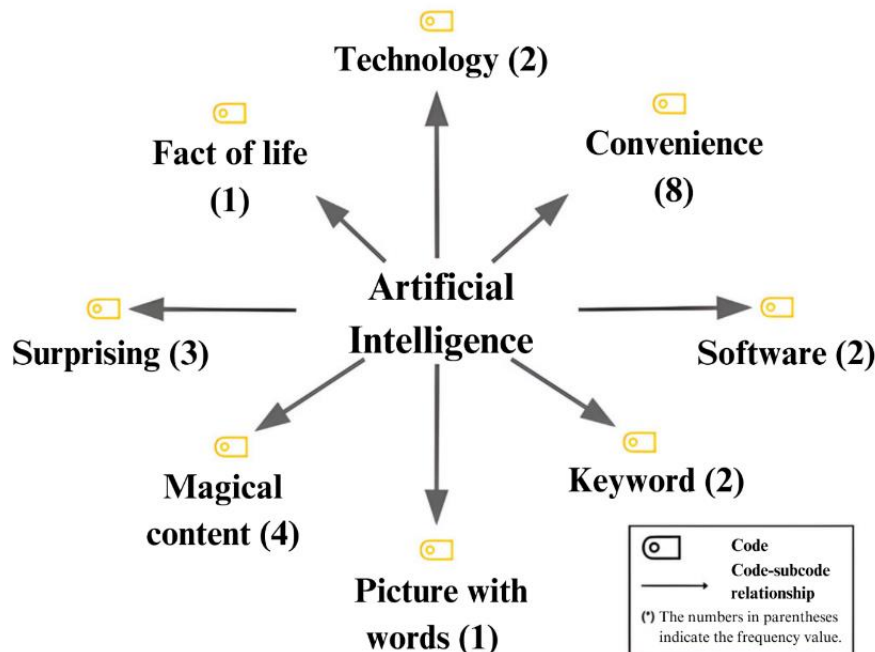


Figure 2. Code Model Showing Teachers' Views on AI and AI Applications

As seen in Figure 2, most of the teachers stated that AI provides convenience (*f*:8). In addition, teachers stated that AI offers people usage options in the fields of software (*f*:2) and technology (*f*:2), that there are different tools such as drawing pictures with words (*f*:1), producing magical content (*f*:4) with words, summarizing a text and expressing it with keywords (*f*:2) and surprising (*f*:3), and that using these tools is a fact of life (*f*:1). The statements of some teachers regarding the codes created are given below.

"...you can't fly, the airplane provides this for you. Thanks to this technology, technology will become the wings of people, and they will fly." (P1)

"When we were preparing the project, there was a very long article, and instead of reading all the information we needed page by page, we asked him to give us a summary of it or express it with keywords for us. He gave us the part we needed by distilling it in a very nice way according to our needs." (P5)

"...artificial intelligence has sentences that surprise me." (P3)

"I make all my designs right now, let me tell you, for special occasions, or you can think of anything related to teacher's day, I make them all from magic content, the only thing I need to do is to enter a few keywords." (P8)

"When I can't find the visual, I want, I tell the magic content what kind of thing I want, for example, a male student who drops his books on the floor, and it creates different kinds of visuals about him." (P2)

"Of course, it is related to artificial intelligence, which is now becoming a fact of life, and I see no problem in using it within certain limits." (P4)

"It is a great advantage to use artificial intelligence applications in a very comfortable and easy way. It saves time for us, and the purpose of technology is to make our lives easier..." (P6)

"When we are working at the middle school or high school level, it facilitates our work in the high school and university placement preference processes of children." (P7)

What are the opinions of teachers on the use of AI in the education process?

The code model showing teachers' views on the use of AI in the educational process is presented in Figure 3.

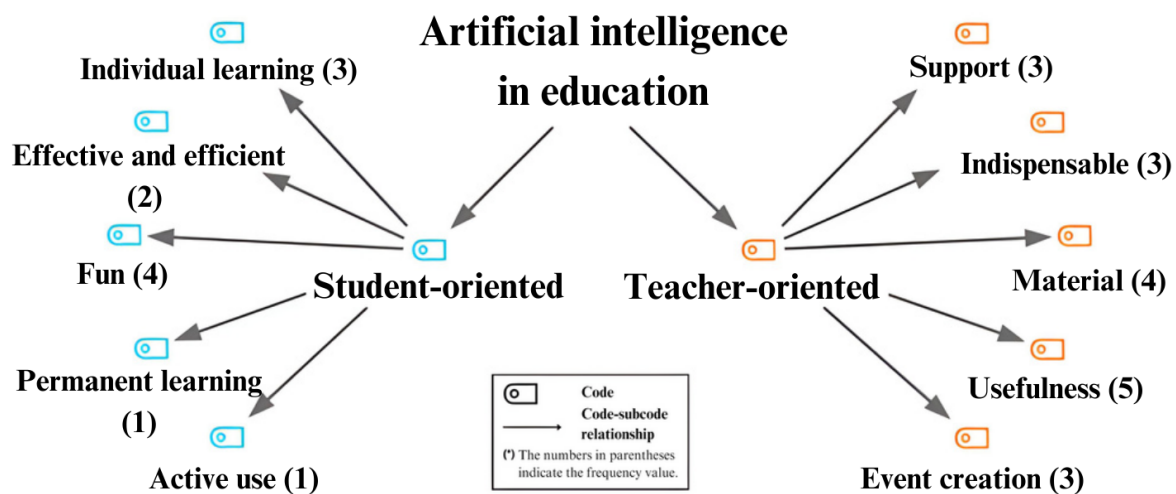


Figure 3. Code Model Showing Teachers' Views on the Use of AI in the Educational Process

As can be seen in Figure 3, teachers' views on the use of AI in the education process are divided into two themes: teacher-oriented and student-oriented. Under the student-oriented theme, opinions were expressed that AI provides students with active use (f:1) and provides personalized individual learning (f:3) opportunities. In addition, it was stated that AI is effective and efficient (f:2), provides permanent learning (f:1), and is fun (f:4) for students. The statements of some teachers regarding the codes created are given below.

"In the evaluation process, he quickly provides feedback and tells the points where the student is missing, so that the student can benefit by providing individual learning without the need for a guide." (P8)

"...the children were shocked; I mean they were extremely surprised because they had never met before." (P1)

"The effect on learning, I can say that they learned more permanently and made the lesson more fun." (P3)

"Artificial intelligence tools make my job very easy for gamifying education and increasing students' motivation. Some tools lead students into an adventure with operations." (P4)

Under the theme for teachers, most of the teachers stated that AI is useful in terms of usefulness (f:5). In addition, they stated that they use it to support (f:3) the teacher in the education and training process, that its use is indispensable (f:3) in today's conditions, and that they use it in creating materials (f:4) and events (f:3) to be used in lessons. The statements of some teachers regarding the codes created are given below.

"From the point of view of teachers, it appeals to primary school and even pre-school, and I think its increasingly widespread use makes it indispensable to be used in lessons." (P2)

"I mean, in all the materials I have prepared, artificial intelligence has a touch, even if it is a point." (P7)

"Sometimes we may find it difficult to teach in class due to fatigue or because of an event we have experienced. We may be tired, we may be on duty, and we may have different special situations in mind. These are external negative factors for our lesson. It contributes to supporting us in such situations." (P6)

"We have feet, why do we get in the car? This does not prevent the development of our leg muscles. If I don't use it, I will fall behind the world, so I think it is indispensable. I will set off at the same time as someone else and if I say I am going with my own feet, I will fall behind." (P1)

"When I want to create open-ended questions while preparing an activity, he directs me by writing sample questions about the role of light in vision." (P5)

What are teachers' views on the advantages and disadvantages of using AI?

The code model showing teachers' views on the advantages and disadvantages of using AI is presented in Figure 4.

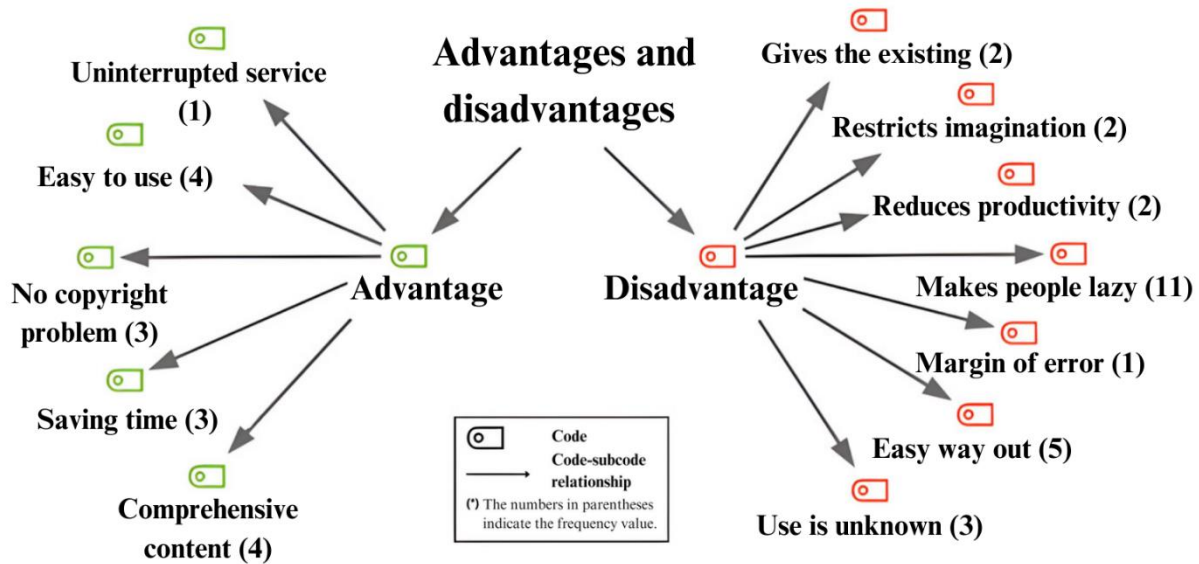


Figure 4. Code Model Showing Teachers' Views on the Advantages and Disadvantages of Using AI

As seen in Figure 4, teachers' views on the advantages and disadvantages of using AI were divided into two themes advantages and disadvantages. Under the advantage theme, the most frequently mentioned views were that AI is easy to use (f:4) and offers comprehensive content (f:4). In addition, the fact that AI provides uninterrupted service (f:1), no copyright problem (f:3), and saving time (f:3) were other views expressed as advantages. The statements of some teachers regarding the codes created are given below.

"It is definitely advantageous for teachers because they can make different sentences by producing comprehensive content in the writing stage, even sentences that we cannot think of." (P2)

"Sometimes we may find it difficult to teach in class due to fatigue or because of an event we have experienced. We may be tired, we may be on duty, we may have different special situations in mind. These are external negative factors for our lesson. It contributes to support us in such situations. Even if you ask these questions to artificial intelligence 24/7, it will continue to serve without getting tired." (P6)

"I mean, can it replace classroom environments or workshop environments like mine, mechanically and theoretically, yes, the other side saturates the student with knowledge and even overwhelms them with knowledge." (P5)

"Since these tests are somewhat comprehensive tests, the use of artificial intelligence-based applications in evaluating and providing feedback facilitates the process both in terms of time and evaluation." (P8)

Under the disadvantage theme, most of the teachers stated that AI makes people lazy (f:11) and leads them to take the easy way out (f:5). In addition, other views expressed as disadvantages were that AI gives the existing (f:2) product without creating a new product, restricts people's imagination (f:2), reduces productivity (f:2), has a margin of error (f:1) and its use is unknown (f:3). The statements of some teachers regarding the codes created are given below.

"Artificial intelligence gives us what exists, yes, we say it produced it, but I write five words there and it gives me a visual, but it gives me this visual from a data in itself." (P1)

"There is a lot of this in visual studies, especially in general, artificial intelligence cannot fully reflect human limbs, feet, and arms in a real way, either it makes them six-fingered, or it removes an extra arm, removes an extra foot, unfortunately, there is a margin of error." (P5)

"Instead of making effort and spending time, we are taking the easy way out, but now we are in the age of technology, we need to use it." (P2)

"It negatively affects the awareness of duty in the student, that is, he does not take the task on himself, for example, you are preparing a project, you are preparing the aims of the project, introduction, summary, etc., results, discussion, questionnaire, etc., the student does everything with artificial intelligence." (P7)

"I think students take it easy, they access information with artificial intelligence, but it is not clear whether this information is true or false or reliable." (P3)

"Ready-made information causes students to be more passive." (P4)

What are the opinions of teachers about the risks that AI may pose?

The code model showing teachers' views on the risks that AI may pose is presented in Figure 5.

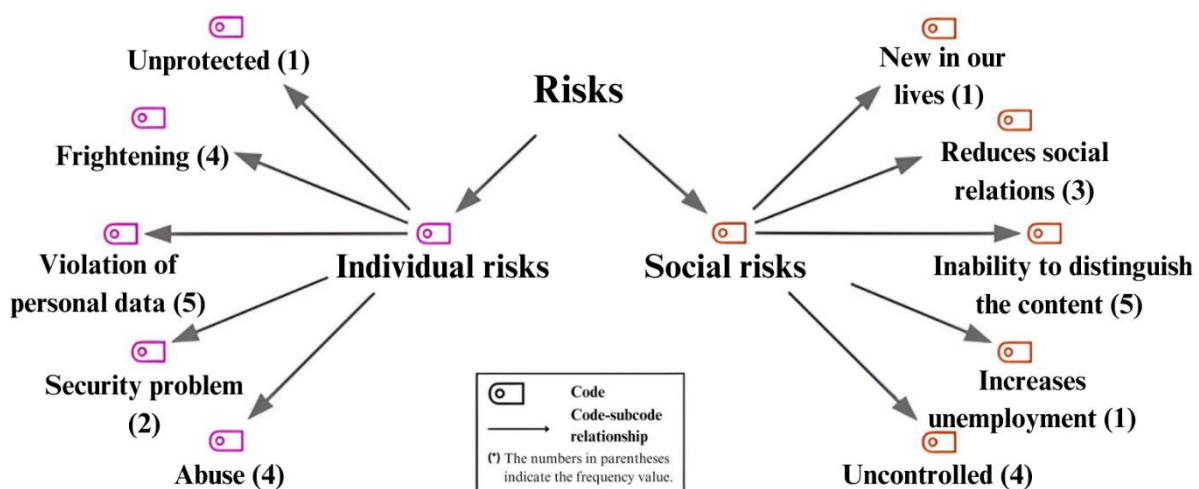


Figure 5. Code Model Showing Teachers' Views on the Risks of AI

As can be seen in Figure 5, teachers' opinions on the risks that may arise from the use of AI are divided into two themes individual and social risks. Under the theme of individual risks, the most frequently mentioned areas were the violation of personal data (f:5) shared during the use of AI, the abuse (f:4) of AI technology, and the frightening (f:4) effects of its dangers. In addition, other opinions expressed were that AI creates an unprotected (f:1) area for students and that there are security problems (f:2). The statements of some teachers regarding the codes created are given below.

"I think there may be problems related to security because we inevitably share our data and these data are collected somewhere, and if they fall into the hands of malicious people, they can be used for different purposes, so security should be given importance." (P2)

"The possibility that a technology might be smarter than me scares people, and I include myself in this, it makes it difficult for people to accept this." (P7)

"Right now, I believe that all personal data is in the hands of someone somewhere. This is already a negative situation, and artificial intelligence can make this negativity even more negative." (P1)

"Since students do not have enough knowledge about this issue, it is an unprotected area for them." (P3)

"Yes, it is a risk factor of course, I mean, in general, for all the people who use it, it does not comply with the data privacy policy anyway, that is, the photo data can be used for malicious purposes in any way." (P5)

Under the theme of social risks, most of the teachers stated that the inability to distinguish the content (f:5) produced with AI may pose a risk. In addition, other opinions expressed as risk factors were that AI is new in our lives (f:1), has an uncontrolled (f:4) area, reduces social relations (f:3), and increases unemployment (f:1). The statements of some teachers regarding the codes created are given below.

"For example, in the Turkish lesson, I gave the student a homework assignment to prepare a summary and bring it to me or create a mini story and bring it to me with artificial intelligence, I absolutely cannot distinguish whether it was made with artificial intelligence or not." (P4)

"The problem with artificial intelligence is that you cannot see content elsewhere, it extracts every content as original content and it is very difficult for a teacher to decipher and reveal it because it is very new in our lives right now." (P1)

"Artificial intelligence has a brain but no heart. No matter how much we use our brains in the teaching profession, artificial intelligence can never completely replace the teaching profession because it is a profession done with the heart." (P8)

"Apart from that, there may be risks, it may reduce human relations. You know, their commitment to other people can reduce their social relations." (P6)

Discussion, Conclusion, and Suggestions

This study aims to examine teachers' views on the use of AI in the educational process. The results of the research show that teachers characterize AI as a surprising and facilitating tool. The purpose of using AI in education has different meanings according to teachers. In the same process, the purposes of use are diversified as supporting educational processes, preparing documents, and providing fun and active usage services. Teachers also think that their students do not view AI technologies in the same way as they do. It has been stated that while this technology provides various advantages, such as easy access to comprehensive content and saving time, it also has significant disadvantages, such as pushing people to laziness, limiting imagination, and having a margin of error in the data it produces. It was concluded that its use may pose existing or potential risks, either individually or socially. In general, it is clear that teachers have a positive attitude towards the phenomenon of AI, but they also have hesitations about the risks that may occur.

In the study, firstly, it was evaluated how teachers perceive and make sense of the concept of AI. According to the findings, teachers characterized AI as a surprising and facilitating technology and software. They stated that they generally benefit from this technology by using its features, such as extracting keywords from the text and creating visuals with words or magical content. In their study with prospective teachers, Çam et al. (2021) concluded that prospective science teachers defined AI as

a structure based on human intelligence, while prospective computer and instructional technology teachers defined it as a technology that can learn. In addition, they stated that teachers frequently associate AI with the concept of a robot. Acemoglu and Restrepo (2020) referred to AI as the study and development of machine-like software and algorithms that mimic human intelligence. The fact that teachers generally associate AI with technological terms is related to the idea that they can increase their knowledge by following current technology (Kılıçer, 2011). This is thought to be related to teachers' branches, their familiarity with the concepts, and their purpose for using this technology. Although the participant group of the study was determined by the maximum variation sampling method, it represents a community that is already interested in technology. It can be said that the teachers' expressions towards AI, whose use in life is becoming more prominent, are generally impressive, useful, and positive, and their awareness of AI is high.

The findings of the study obtained from teachers' opinions on the use of AI in the educational process show that the use of AI in the educational process has different meanings and serves different purposes according to teachers. According to the teachers, students can learn effectively, efficiently, and individually with AI, and that permanent learning can be achieved in students thanks to fun and active use; teachers use AI as an indispensable and useful support tool to prepare various materials and activities. It is thought that AI can help teachers better understand the needs of their students and provide more effective support by identifying learning gaps. Tekgüç and Adalier (2019) stated that teachers should use AI technology to analyze student needs and create the learning processes needed. In this way, it will provide effective benefits by increasing the quality of education and supporting student success. In the research conducted by Çam et al. (2021), it was concluded that AI can be used to teach lessons, enrich the teaching process, provide supportive benefits for the teacher, and make student evaluations. It can be said that the use of AI in education should be adopted to provide feedback by tracking student performances, facilitate classroom management (Özer et al., 2023), use it as a teacher assistant, provide individualized learning services by analyzing student needs and behaviors (Nabiyev & Erümit, 2020), and increase the quality of education (Taşçı & Çelebi, 2020). Learning environments supported by AI technologies play an important role in providing students with individual learning experiences and personalizing the learning process (Kış, 2019). Learning environments supported by this technology can offer content according to students' learning styles, speeds, and needs. In this way, each student can progress at their own pace and receive support by their learning needs. It also supports teachers in monitoring students' performance, identifying their strengths and weaknesses, and providing feedback on students' progress. As a result of their study, Özer et al. (2023) concluded that AI-supported instructional materials have an important role in increasing student achievement. They stated that this is since AI creates individualized teaching plans for the needs of the student and provides efficient learning environments that develop thinking skills. Similarly, Soydemir Bor and Alkış Küçükaydın (2021) concluded in their study that AI-supported instruction contributed to high-level cognitive skills such as problem-solving and creative writing in students. In these studies where AI-based teaching is applied, the positive effect of individual learning stands out. It is thought to arouse interest in students, to be suitable for individualized learning and to increase students' success by providing a more effective and efficient experience in education.

Another problem of the research is to reveal the advantages and disadvantages of using AI. Based on the findings, it was concluded that the advantages of AI are that it provides continuous uninterrupted service, is easy to use, comprehensive content can be accessed without copyright problems, and saves time; while the disadvantages are that it reduces human productivity and makes people lazy, pushes people to take the easy way out, limits imagination, does not know how to use it, has a margin of error, and is limited to the data available in the existing data of AI. In the studies conducted, the advantages of AI are individual learning, speed, convenience, improving visual intelligence, reducing human errors (Özer et al., 2023), saving labor and time (Çam et al., 2021), systematic storage of large amounts of data, ease of access to information (Nabiyev & Erümit, 2021), facilitating the preparation of materials and plans used in the educational process, improving creativity skills (Kaya, 2023), and increasing student participation (Freeman et al., 2017). Along with these benefits, disadvantages such as not being accessible to everyone, having high costs, being difficult to use in crowded classrooms (Özer et al., 2023), making people lazy, offering limited usage areas (Çam et al., 2021), having the possibility of increasing unemployment (Nabiyev & Erümit, 2020), reducing research skills (Demir Dülger &

Gümüşeli, 2023), lacking emotion, and not providing motivation and confidence (Çetin & Aktaş, 2021) are among the results reached. Çam et al. (2021) stated in their study that pre-service teachers from different branches stated that the rate of advantages provided by AI is higher compared to its disadvantages. While speed, practicality, and time savings stand out as the most important advantages, challenges such as high cost and not being accessible to everyone should also be taken into consideration. Reducing the cost and ensuring equal access are critical for the use of AI. By anticipating the possible benefits and harms of AI, which can be encountered in all areas of life, it can be integrated more effectively into the education system, and thus the quality of education can be increased.

The last problem of the research is to determine the risks that AI may pose. In the findings obtained, existing or potential risks were evaluated separately as individual and social. Situations such as the violation of personal data shared directly or indirectly while using AI services, being an unprotected area due to the lack of a secure usage area, being abusable for malicious purposes, and the fear that these possibilities create in people are evaluated as individual risks. As social risks, the fact that it is very new in our lives, the lack of a control mechanism, and the inability to distinguish the content produced with AI from other content were stated as important risk factors. Similarly, there are various studies in the literature that support the results of the research and conclude that the storage of personal data by AI creates ethical drawbacks, teachers do not have sufficient knowledge, there are data security concerns, and there are hesitations about security (Jones & McCoy, 2018; Çetin & Aktaş, 2021; Özer et al., 2023). Participants stated that they could not distinguish whether the products created were prepared directly with AI or not. Vetter et al. (2024), in their study focusing on the ethical concerns that arise in writing texts with AI, stated that they were constantly in doubt about whether the work was the product of the student or the AI. It is evident that the ethical and safety aspects of AI-based learning tools are important for teachers. Teachers are responsible for ensuring the privacy and security of both students' and their personal data during the use of these tools. Holmes and Porayska-Pomsta (2023) stated that the ethical use and sustainability of these technologies in education and training processes are vital. It is thought to be important for teachers to be aware of ethical and security issues related to the use of AI-based tools. Teachers should be regularly trained by educational institutions on ethical and safety issues, and awareness-raising activities should be carried out. In addition, it is thought that teachers need supportive training to use the opportunities it will provide effectively. Dakakni and Safa (2023) found in their study that students benefit from AI but have concerns about data security and that teachers are ready to receive training on AI to protect their students against potential risks. Providing teachers with access to up-to-date information and resources on this subject will enable them to use AI-based learning tools ethically and safely and protect the privacy of their data.

Teachers stated that AI may also have significant effects on society, reduce social relations, and increase unemployment. Similarly, Kaya (2023), in his study with teachers, concluded that communication between people will weaken and therefore affect social skills. It was stated in their study that the values we have will also be negatively affected by the weakening of social skills. Other studies conclude that the use of AI and other technologies in education can reduce students' social interactions, make learning experiences difficult, and weaken teacher-student relationships (Saengudomlert & Wongwanich, 2019; Selwyn, 2017). To prevent or reduce these negative consequences, it is important to use technology in a balanced and effective way. In addition to technology-supported learning methods, interactive activities such as group work, discussions, and project-based learning should be encouraged to increase students' social interactions.

Numerous questions around AI persist, which will impact nearly every domain in the future. The implementation of AI applications in education prompts critical inquiries regarding curriculum content and methodology, the transforming role of educators, and the social and ethical ramifications of this technology (Adams et al., 2023). The adaptation of personal learning offers substantial advantages, including enhanced access to and processing of extensive data, less waste of time and resources, and the realization of individual potential; nevertheless, these advantages are accompanied by inherent hazards. Both anticipated and unanticipated dangers necessitate discussion and investigation, including concerns over personal data privacy and security, equitable and precise allocation of services, errors, and the potential impact on various employment sectors.

Suggestions

- Applied research on the use of AI in education should be conducted to clarify the positive and negative aspects of AI.
- The participant group of the study represents a community that is currently interested in technology determined by maximum variation sampling method. Therefore, survey research with different sampling methods can be conducted to generalize the results.
- It is suggested that workshops and online trainings should be organized on the potential and conscious use of AI technologies, taking into account teachers' ethical concerns, risk factors and lack of knowledge in their use.
- Since it is a new and developing technology, the effects of using AI technologies in education should be evaluated with long-term studies in order to prevent problems that may be experienced in the process of adaptation to educational processes and to determine the effects it will create in the future.

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Teaching and Learning Pronunciation: EFL Learners' Views and Instructors' Practices

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Abstract

The discussion surrounding the significance of pronunciation in communication, both in a first language (L1) and a second language (L2), has been a subject of ongoing debate. Previous research has predominantly focused on exploring teachers' techniques and practices regarding pronunciation instruction, as well as investigating students' opinions and perceptions. This study seeks to enhance our understanding of pronunciation instruction within an English as a Foreign Language (EFL) context by offering insights into both learners' views and instructors' practices jointly. Conducted as a mixed-method study, the research investigated the perspectives of both students ($n = 112$) and instructors ($n = 14$) on the learning and teaching of pronunciation. The findings revealed that learners placed considerable importance on pronunciation instruction and expressed a preference for audio-visual materials, repetition, and imitation techniques respectively. On the contrary, the majority of instructors, who reported including pronunciation in their teaching, emphasized the effectiveness of focusing on the phonetic alphabet the most, while considering textbook-based activities to be the least effective component of their instructional repertoire. These findings may contribute to a better understanding of the teaching and learning of pronunciation in an EFL context and could help inform future instructional strategies and educational practices.

Keywords: Pronunciation instruction, L2 pronunciation learning, teaching practices, EFL learners.

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Introduction

Since comprehensible and intelligible pronunciation is a fundamental necessity of everyday communication, it stands out as a crucial aspect of language teaching (Monika et al., 2019). Therefore, in foreign language teaching practices, teaching pronunciation has become one of the priorities, driven by the widely held belief that a strong proficiency in pronunciation may positively correlate with effective oral communication (Aydın & Akyüz, 2017). However, perspectives on the role of pronunciation instruction have changed (Diller, 2020). According to Atli and Bergil (2012), the systematic study of pronunciation began to take shape towards the conclusion of the 20th century, marked notably by the establishment of the International Phonetic Association in 1886. Subsequently, the emphasis placed on pronunciation teaching in English as a Second Language (ESL)/EFL classrooms has experienced fluctuations (Diller, 2020). Traditional methodologies such as Grammar-Translation Method and the Reading-Based Approach tended to place less emphasis on pronunciation instruction whereas subsequent methods such as the Oral Approach and the Audiolingual Method assigned it a more central role, which may have shaped the current teaching practices (Aydın & Akyüz, 2017; Celce-Murcia et al., 1996). For instance, formerly used pronunciation improvement techniques such as repetition, imitation and phonetic alphabet tool were started to be replaced with using digital devices and AI chatbots (Hoang et al., 2023). In the meantime, how pronunciation is perceived by learners has shown variations as well. In the the so-called post-method era (Kumaravadivelu, 2006) where intercultural and international communication has gained momentum thanks to the so-called *globalization*, the earlier goal of sounding just like native speakers of the target language has shifted to intelligibility and comprehensibility issues as the ownership of the languages has been questioned (Derwing et al., 2014; Sifakis, 2004). In this sense, Tsunemoto et al. (2023) put forward that comprehensibility means how easily listeners perceive and understand speech whereas intelligibility is more narrowly focused on clear and accurate pronunciation. That is, intelligibility, as emphasized by Thomson and Derwing (2015), goes beyond the essential requirement of sounding native-like in speech and pronunciation. No matter how comprehensible speech is and how intelligible pronunciation is, ultimately meaningful communication in an L2 is valued and emphasized (Edo-Marzá, 2014; Gilakjani, 2016). Although teaching approaches have evolved, pronunciation instruction remains a neglected area in Turkish EFL classrooms and receives less attention than other language skills despite its crucial role in communicative competence (Üstünbaş, 2018). To address this knowledge gap, this study investigates teachers' and students' expectations, perceptions, and practices related to pronunciation instruction by examining commonly used techniques and activities in language classrooms and L2 English textbooks (e.g., repetition, word stress, singing songs). Additionally, it responds to calls for research by Xuyen (2019) and Quoc et al. (2021) on exploring both teachers' and students' practices and Jafari et al. (2021) on in-class pronunciation instruction. By bridging the gap between instructors' teaching practices and learners' expectations, this study aims to offer a more comprehensive understanding of pronunciation instruction in Türkiye to contribute to novel pedagogical strategies, curriculum development adaptations, and teacher training programs. Strengthening pronunciation instruction can also enhance learners' intelligibility, boost their confidence in spoken communication, and better equip them for academic and professional settings where English is increasingly required. Given the growing importance of English in Türkiye and global contexts, improving pronunciation teaching can contribute to the development of more competent speakers who can engage successfully in global communication. In this regard, the study provides practical recommendations for educators and policymakers to enhance pronunciation instruction by ensuring that it is more effectively integrated into foreign language education. The following sections review relevant literature from the perspectives of learners and instructors, identifying key research areas and emphasizing the significance of studies aimed at improving L2 pronunciation instruction.

Literature Review

Regarding the learners, their beliefs about pronunciation have been identified as crucial factors in the learning process, influencing the ultimate outcomes of the learning experience. (Barcelos & Kalaja, 2013). Previous studies have commonly involved preferences, goals, and attitudes of the learners toward pronunciation instruction (Lintunen, & Mäkilähde, 2018). In several of them (Ahmad &

Nazim, 2014; Edo-Marzá, 2014; Lintunen & Mäkilähde, 2018) students stressed a lack of pronunciation instruction and their willingness to be trained in that specific area of language. For instance, in Monika et al. (2019)'s study conducted in Indonesia with 22 students, a huge majority of the students emphasized the importance of pronunciation and 54.5% of them expressed the belief that they lacked opportunities to practice English pronunciation. An additional 45.5% felt that they also lacked opportunities to practice outside the pronunciation class. Likewise, in Xuyen (2019), 50 university students maintained that they consider pronunciation as the key to effective communication, 70% felt they lacked real-life opportunities to use English, and 64% admitted their current learning methods were inadequate. In another recent study, Almusharraf (2022) investigated Saudi EFL learners' confidence, attitudes, and practices regarding pronunciation. Using a sample of 336 university students, the study found that learners had above-neutral confidence and highly positive attitudes toward native-like pronunciation. However, no significant difference in confidence was observed between those who had taken a phonetics course and those who had not. The study highlights the need for instructors to address learners' pronunciation needs with appropriate materials and practice opportunities.

In addition to the studies on beliefs and opinions, some researchers explored students' preferences and expectations about specific pronunciation teaching techniques and activities. In Kusz and Pawliszko (2022), the Polish students ($n = 112$) who were asked to order which pronunciation tasks were most preferable for them reported that listening to recordings from textbooks was the top preference, and this was followed by immediate feedback. Participants also favored traditional pronunciation learning activities over modern/technological ones. Similarly, Pawlak et al. (2015) concluded that 110 third-year university students strongly preferred a structural syllabus with preselected pronunciation features and stated overwhelming support for teacher correction. Echoing Kusz and Pawliszko (2022), Dao's study (2018) revealed that minimal pair drills, teachers' use of songs, poems, and jokes, and repeating after models were identified as the most effective methods for pronunciation teaching. Lastly, Derwing and Rossiter (2002) put forward that 100 ESL learners reported self-repetition, paraphrasing and volume adjustment as the most effective techniques to solve the communication problems caused by pronunciation. All in all, while the studies reviewed above consistently highlight students' desire for increased pronunciation instruction, their preferences for specific techniques, methods, and activities exhibit considerable diversity. This variation highlights the importance of tailoring pronunciation teaching to meet differing learner needs and preferences. Moreover, it suggests the necessity of balancing traditional methods with modern, technology-enhanced approaches to maximize engagement and effectiveness. The upcoming section is dedicated to the teachers' perspective on the same issue.

Regarding instructors, there has been a notable increase in efforts to explore their thoughts and actions in various ESL and EFL settings concerning L2 pronunciation instruction in recent years. In most of these studies, the importance of pronunciation instruction has been emphasized (Tegnared & Rentner, 2021; Uzun, 2022) by the teachers involved. However, fewer studies have delved into the specific activities employed by in-service EFL teachers for teaching pronunciation. Among these, some suggest the prevalence of traditional activities with a focus on segmental features (e.g., phonemes, consonants & vowels, diphthongs, etc.). Alsofyani and Algethami's (2017) research carried out with 57 teachers in Canada indicated that they predominantly employed segmental activities, such as utilizing phonetic symbols, individual sound exercises, and minimal pairs. Likewise, Buss (2015) asked 60 teachers to complete an online questionnaire regarding their pronunciation instruction techniques and they ($n = 22$) mentioned engaging in segmental activities, such as conducting perception and sound discrimination exercises. Besides, they were inclined to prioritize word-level features, particularly individual sounds, and heavily relied on activities centered around repetition and the use of the phonetic alphabet. The studies that unearthed repetition as a preferred technique were not limited to these scholars. Jafari et al. (2021)'s research that involved 74 EFL teachers completing a questionnaire and taking part in interviews in the Iranian EFL context revealed their preference in favor of drama, role-play and imitation & repetition respectively. To add, Wahid and Sulong (2013) investigated 27 ESL teachers' rationales that underlie their pronunciation teaching practices. Their findings illustrated that repeating after the teacher, reading aloud and dictionary usage were listed as the most preferred techniques. Another noteworthy study published by Yulia and Saukah (2021) shed

light on our understanding of Indonesian teacher educators' beliefs and practices. According to them ($n = 3$), drilling was the most effective method for developing mechanical habits, which indicated a preference for traditional teaching techniques due to their perceived merit. Unlike the previous researchers who collected data from a single homogenous sample group, Szyszka (2016) questioned teachers' beliefs about pronunciation teaching at three distinct education levels in Poland. The findings suggested that primary school teachers indicated frequent use of instructional strategies, with acting out dialogues with learners and repetitions, both after teacher-led demonstrations and recordings. Reading aloud emerged as the most employed technique among lower secondary school teachers, while repetition after recordings attained heightened popularity within the higher secondary teachers group. As this study also aims to do, and unlike most other studies, Nguyen et al. (2021) examined both teachers and students within the same research. They explored teachers' and learners' beliefs about pronunciation instruction in Vietnamese tertiary EFL education through semi-structured interviews with six teachers and focus groups with 24 students. The findings revealed a shared belief in the importance of explicit and systematic pronunciation instruction and the potential of communicative approaches to enhance pronunciation and overall communicative skills. The study highlights implications for curriculum design and pronunciation pedagogy.

It is worth noting that even though the respondents showed appreciation towards repetition drills, several research findings demonstrated a preference for other instructional techniques and activities. The participants ($n = 3$) in Quoc et al. (2021)'s case study implemented a combination of visual reinforcement, and feedback in the form of audio and phonetic transcriptions in the teaching of pronunciation. As another support for this line of inquiry, Hismanoglu and Hismanoglu (2010) surveyed 103 teachers in North Cyprus and the findings revealed that the preferred techniques for teaching pronunciation were reading aloud, utilizing dictionaries, and engaging in dialogue practice. As the ultimate studies to be briefly elucidated, teacher cognition regarding teaching pronunciation has been investigated by Baker (2013) and Yunus et al. (2016). The former researcher interviewed five teachers and concluded that they primarily relied on controlled pronunciation techniques by manipulating them extensively and regarded them as less communicative. Guided techniques (viz. semi-structured) were infrequently used, indicating potential limitations in consistently incorporating them into oral communication curricula. On the other hand, Yunus et al. (2016) whose article bears a strong resemblance to Baker (2013), reported that the core of teachers' instruction centered around explanations and examples, activity set-up, and checking activities, all falling within the realm of controlled activities, but teachers in lower-level classrooms incorporated certain "free techniques" such as drama and games.

When it comes to Turkish EFL context, the studies carried out regarding pronunciation instruction are quite scarce. To our knowledge, Yağız (2018) investigated 164 English teachers' cognition concerning L2 pronunciation. It was highlighted that the teachers' pronunciation practices were limited to transcription exercises. This study did not tap into students' expectations, beliefs and perceptions. Other scholarly endeavors involved researching methodological concerns (Bakla & Demirezen, 2018; Yakut, 2020) or pre-service teachers (Uzun, 2022).

In sum, recent research on pronunciation instruction highlights the importance of diverse techniques, ranging from traditional approaches like repetitions and drills to activities such as drama and games. However, limited studies in the Turkish EFL context have explored both teachers' practices and students' beliefs within the same research. This study addresses this gap by examining both perspectives simultaneously and aims to provide a comprehensive understanding of L2 pronunciation instruction and learning. As a result, the following research questions were formulated:

1. What beliefs, views and expectations do EFL students in higher education hold about pronunciation instruction and learning?
2. Which pronunciation improvement techniques do EFL students in higher education find most and least effective?
3. Which pronunciation improvement techniques do EFL instructors find most and least effective?

Method

A convergent parallel mixed-methods research design was employed because comparing different perspectives drawn from both quantitative and qualitative data strands was necessary to obtain a more comprehensive understanding of the research problems (Caruth, 2013; Creswell, 2017). That is, it was intended to check whether there is congruency between the practices of instructors and their reasons, and the views of students. For the quantitative part, a 5-point Likert scale was implemented to capture students' views. This methodological decision not only facilitated the systematic analysis of data but also enabled the quantification and measurement of the degree of agreement or disagreement among participants. The structured nature of the Likert scale provided a standardized framework for participants to express their opinions, enhancing the overall rigor and reliability of the research findings. For the qualitative part, semi-structured questionnaire was used to obtain an in-depth understanding of instructors' practices regarding pronunciation. By adopting this methodology, rich and detailed insights were gathered from instructors, which enabled a deeper understanding of their perspectives, strategies, and experiences related to pronunciation instruction. In the end, two strands of data were merged, and further analyses were conducted.

Participants

Student participants

The number of student participants for this study was 112 to reach more generalizable results. All of them were asked to sign an informed consent form in Turkish and participate only if they were willing to do so. They were chosen through convenience sampling (Etikan & Bala, 2017). The participant group can be considered highly homogenous given that all of them were placed in the pre-intermediate level classes at a state university's language preparation school based on an institutional placement test. Besides, they all have been through 27 hours of instruction in English per week from the beginning of the semester till the data collection time. In addition, all of them reported Turkish as their L1 and no hearing and speaking impairments. Their age ranged from 17 to 24, yielding an average age of 18.52. Among the participants, 91.07% ($n = 102$) identified as male, 6.25% ($n = 7$) as female, and 2.68% ($n = 3$) chose not to disclose their gender. Participants indicated an average duration of 8.26 years ($R = 1-12$, $SD = 2.16$) devoted to studying English. The mean self-reported score for pronunciation proficiency, assessed on a scale of 10, was recorded as 6.01 ($SD = 1.48$). Finally, a subset of participants ($n = 37$) reported having received instruction or training in pronunciation during either their primary or secondary education, while the remaining participants ($n = 75$) asserted that they had not undergone formal training in pronunciation.

Teacher participants

A total of 21 EFL instructors working at a state university's school of foreign languages in Türkiye were requested to participate in the study. They were chosen by means of purposive and convenience sampling methods (Etikan & Bala, 2017). The purposive sampling was used because all selected instructors share common specific characteristics such as being the main course teacher at the pre-intermediate level, teaching at least around 20 students in their classes, and having experience in language teaching for more than three years at the same institution. Additionally, the convenience sampling method was utilized since the participant pool was chosen based on their ease of accessibility to us. However, upon receiving the responses of the 14th teacher, it was observed that the data reached a saturation level (i.e., new data reiterated what had been conveyed in earlier data) as recommended by Hennink and Kaiser (2022), so no further participants were requested. To mention their demographic information, of whom 10 people identified themselves as female and 4 as male, the average age was 30.38 ($SD = 2.3$, $R = 27 - 43$) and they had an average of 6.84 years of teaching experience ($SD = 3.6$, $R = 4 - 23$).

Data Collection Instruments

The instruments for data collection include a 5-point Likert Scale for learners (Appendix 1) and semi-structured (mixed-format) questionnaire for instructors (Appendix 2). The first data collection instrument consists of three parts. In the first part, the participants were required to provide details about themselves like their age, gender, years of studying English, and their self-reported

pronunciation level (0-10). In the second part, the respondents indicated their beliefs and opinions concerning pronunciation on a scale that ranges from 1 (strongly disagree) to 5 (strongly agree). The permission to use the scale was obtained from Pawlak et al. (2015) via email. This survey concluded with the third part regarding their opinions about specific pronunciation improvement techniques. Note that the same activities were asked to the instructors to check whether a congruency exists between these two participant groups. The second tool directed to the instructors included open-ended responses such as reason(s) for (not) teaching pronunciation, choice of instructional technique and their reasons. The second item was specifically placed as the same pronunciation teaching practices were provided in the questionnaire that was provided to the students in the Likert scale format.

Data Collection and Analysis

Prior to the data collection process, ethical clearance was obtained. Then, the data were collected in two concurrent phases, both lasting from 29.11.2023 to 29.12.2023 and completed by the first author. The first phase involved data collection from the students. They were given the questionnaire at a class hour in other instructors' lessons. Printouts were used considering the potential technological problems of online data collection. In the second phase, semi-structured questionnaires were collected via the SurveyMonkey web tool (<http://www.surveymonkey.com>). The instructors were directed to the survey via a link, and they were supposed to send their responses in English.

To specify the analysis part for the quantitative phase, the collected responses were entered into an Excel spreadsheet. To ensure accuracy, the entered data were crosschecked twice by both researchers. After that, the data were analyzed on The Jamovi Project (2024) to run the statistical tests and calculate descriptive statistics. As for the scale given to the student participants, a series of analyses were conducted. First, the Kaiser-Meyer-Olkin (KMO) value for the factor analysis conducted on the scale was calculated as .679. Accordingly, the sample size is suitable for factor analysis ($KMO > .500$). Within the scope of the Bartlett's test, the χ^2 value was calculated as 709.681 and found to be statistically significant ($p < .05$). Therefore, the assumption of normal distribution was met. Based on the KMO and Bartlett's test results, it was concluded that the data are suitable for further factor analyses. Table 1 below indicates the first step of such analyses.

Table 1.
Exploratory Factor Analysis Results

	Factor 1	Factor 2	Factor 3	The ratio of explained variance (%)
Item20*	0.746			
Item1	0.723			
Item18	0.664			
Item12	0.628			22.101
Item22*	0.540			
Item21*	0.506			
Item8	0.407			
Item13		0.696		
Item10		0.657		
Item6		0.651		
Item5		0.634		
Item4		0.618		14.272
Item7		0.607		
Item2		0.580		
Item3		0.485		

Table 1 continuing

Item15	0.821	
Item14	0.721	10.076
Item16	0.652	
KMO = .679		
$X^2 = 709.681$		
$p < .001$		

As shown in the table above, as a result of the factor analysis, Item 11 was excluded due to cross-loading, while Items 9, 17, and 19 were removed from the analysis due to factor loadings below 0.40. It is also necessary to mention that factor 1 consists of seven items, with factor loadings ranging from 0.407 to 0.746. The explained variance ratio of this factor is 22.101%. Factor 2 consists of eight items, with factor loadings ranging from 0.485 to 0.696. The explained variance ratio of this factor is 14.272%. Factor 3 consists of three items, with factor loadings ranging from 0.652 to 0.821. The explained variance ratio of this factor is 10.076%. In total, the explained variance ratio of the scale is 46.449%. While the factor loadings and explained variance ratios provided initial insights into the factor structure, a scree plot (Figure 1) was examined to further determine the optimal number of factors (Pallant, 2011; Sağdıç & Şahin, 2015).

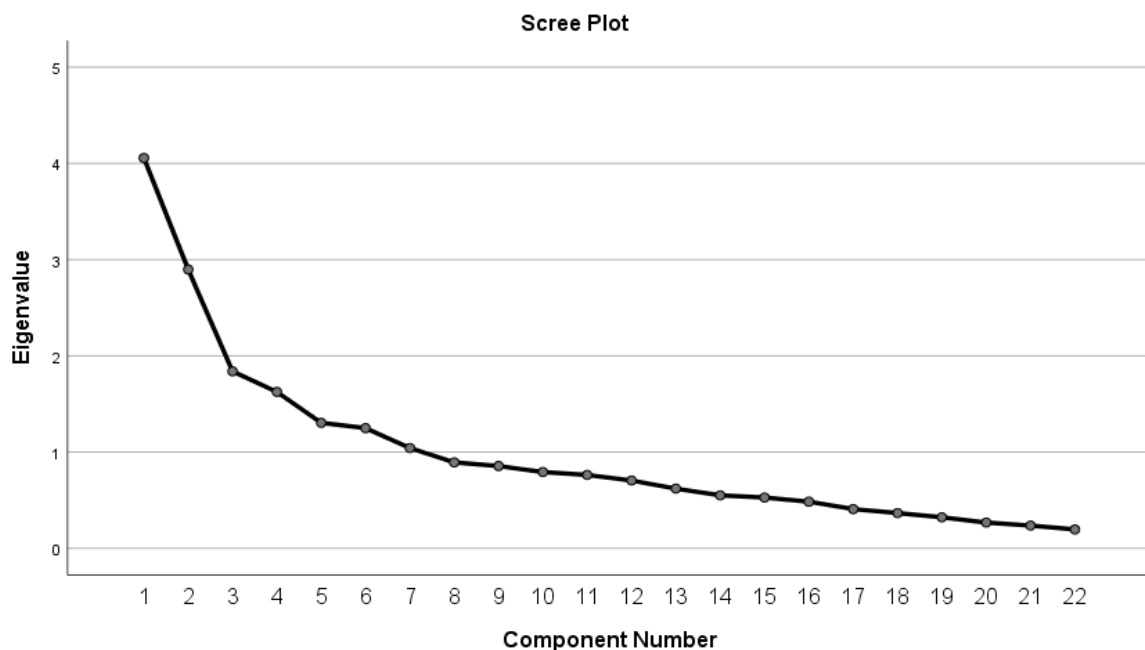


Figure 1. Scree Plot Showing the Eigenvalues for Factor Extraction

Figure 1 above illustrates that the eigenvalues decreased sharply before leveling off at the fourth component, which suggested a four-factor structure. However, in this configuration, one of the dimensions exhibited low reliability. To further validate the factor structure, parallel analysis was conducted. The results indicated that the first three factors had actual eigenvalues of 4.25, 2.80, and 1.95, which exceeded the corresponding simulated eigenvalues of 1.75, 1.60, and 1.45 from the random data. This finding supports the retention of a three-factor solution. Consequently, after further refinement, a three-factor structure was determined to be the most appropriate. After establishing the three-factor structure through exploratory factor analysis (EFA), a confirmatory factor analysis (CFA) was conducted to evaluate the model's fit and assess the validity of the identified factor structure.

Table 2.
Confirmatory Factor Analysis Results

Acceptable Fit Indices	Calculated Fit Indices
$\chi^2/df \leq 5$	1,43
$GFI \geq 0,90$	0,91
$AGFI \geq 0,85$	0,86
$CFI \geq 0,90$	0,94
$RMSEA \leq 0,08$	0,06
$RMR \leq 0,08$	0,07

The CFA results indicate that the proposed three-factor model demonstrates an acceptable fit to the data. The χ^2/df ratio (1.43) falls well within the recommended range (≤ 5), which suggests a reasonable model fit. The Goodness of Fit Index ($GFI = 0.91$) and Comparative Fit Index ($CFI = 0.94$) exceed the 0.90 threshold, which further support model adequacy. The Adjusted Goodness of Fit Index ($AGFI = 0.86$) is slightly below the commonly accepted threshold but remains within an acceptable range. The Root Mean Square Error of Approximation ($RMSEA = 0.06$) and Root Mean Square Residual ($RMR = 0.07$) both fall within the recommended limits (≤ 0.08) and indicate a well-fitting model. Overall, these results confirm that the three-factor structure is statistically supported. To further illustrate the relationships between the latent factors and their respective observed variables, Figure 2 below presents the path diagram of the CFA model, including standardized factor loadings and factor correlations.

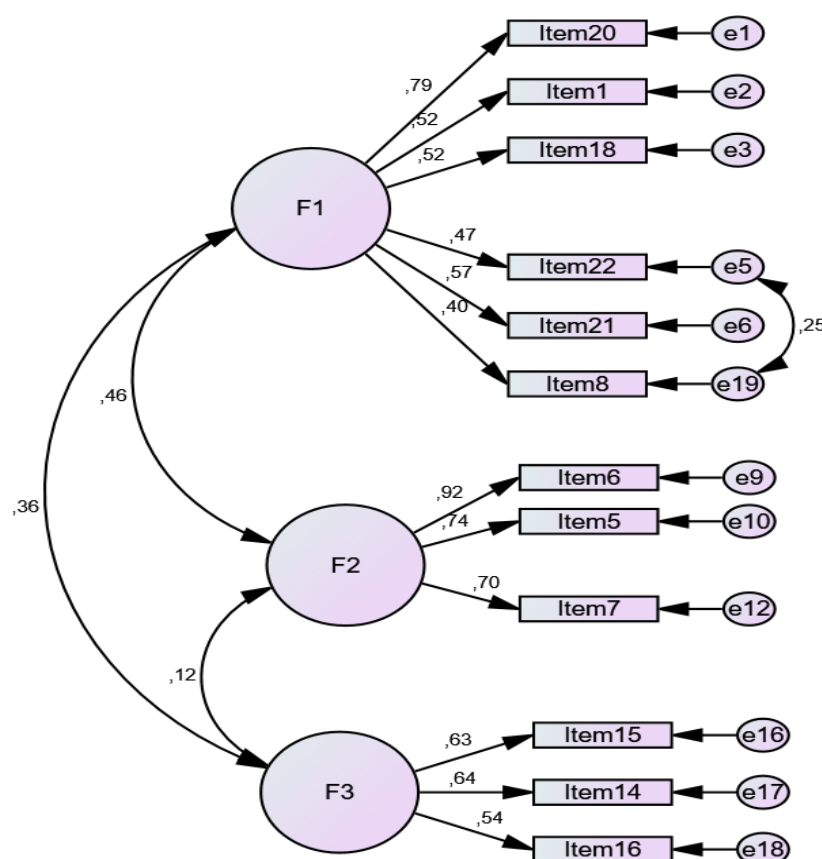


Figure 2. Path Diagram of the CFA Model and the Factor Loadings Per Item

In the CFA conducted, items 12, 13, 10, 4, 2, and 3 were excluded due to low factor loadings. In the final model, all factor loadings were 0.40 or above and statistically significant ($p < .05$). After confirming the three-factor structure, internal consistency was assessed using Cronbach's alpha. The reliability coefficient was high for factor 2 ($\alpha = 0.820$) and moderate for factor 1 ($\alpha = 0.722$) and factor

3 ($\alpha = 0.611$). The overall scale demonstrated acceptable reliability ($\alpha = 0.759$). A comparison with the original scale by Pawlak et al. (2015) consisted of 28 items across six dimensions, with an overall Cronbach's alpha of 0.77. While the original scale's validity was supported through factor analysis, some subscales showed lower reliability. In contrast, the adapted version in this study resulted in a three-factor model with a final reliability of 0.759 and this aligns closely with the original scale's overall reliability. Factor-level reliability scores for the adapted version were 0.722, 0.820, and 0.611, indicating moderate to high internal consistency. Another key difference is that the original scale identified six factors related to students' perceptions of pronunciation instruction, including syllabus design, instructional techniques, and corrective feedback. However, in this study, factor analysis consolidated aspects of pronunciation learning into three broader categories: motivation and engagement, emotional barriers, and beliefs about learning pronunciation. This adaptation likely reflects the revised focus of the scale and the characteristics of the participant group. Based on factor analyses, items related to learners' concerns and effort were categorized under motivation and engagement with pronunciation learning (items 20, 1, 18, 22, 21 and 8), while those reflecting discomfort and nervousness were grouped under positive attitudes toward pronunciation learning (items 6, 5 and 7). The third factor, beliefs about pronunciation learning, included items addressing whether pronunciation is learned through practice or considered an innate ability (items 15, 14, and 16). The factor names in this study were determined based on the thematic content of the retained items. The results and their interpretations will be discussed in detail in the next section.

As for the qualitative part, the data were analyzed on MAXQDA Analytics Pro (24.0.0) by abiding by the principles of thematic analysis (Braun & Clarke, 2021) which comprises several key steps. In this approach, the data were initially immersed through repetitive readings to become familiar with its content. Initial codes and subcodes were then generated, identifying significant concepts or phrases within the dataset. The coding process was conducted collaboratively by both authors to ensure reliability and consensus in identifying meaningful patterns. These codes were subsequently organized into potential themes, reflecting broader patterns of meaning. In addition, memos and codebooks were constantly updated for a thorough analysis. Through an iterative process of review and refinement, themes were carefully defined and named to capture their essence. A narrative was then constructed that weaves together these themes, creating a coherent and meaningful story. Rigorous checking against the original data ensured the accuracy and authenticity of the identified themes. Finally, the analysis was presented in a clear and comprehensive report, supported by illustrative examples from the data.

Findings

Scale

This section demonstrates the results yielded from the scale to address the research questions. The presentation of findings follows the structure of the factor analysis results and thus reflects the identified factors in order.

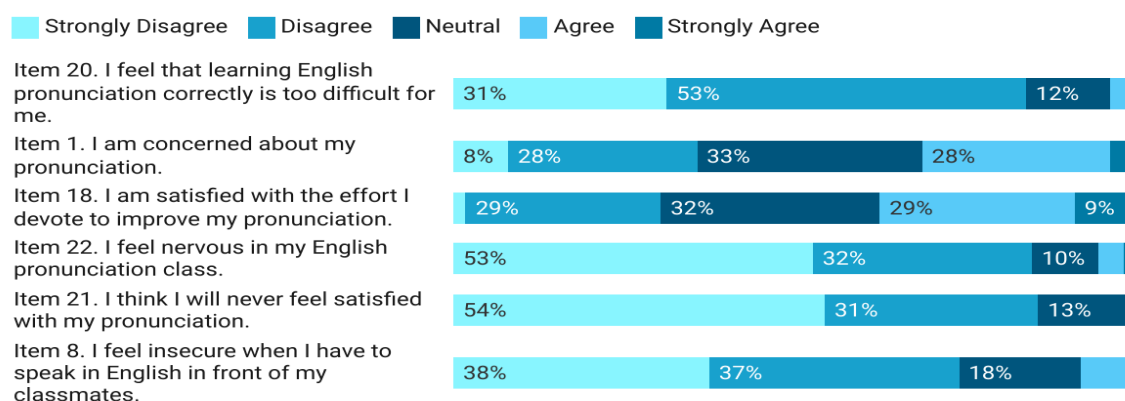


Figure 3. Motivation and Engagement with Pronunciation Learning

Figure 3 illustrates students' motivation and anxiety toward pronunciation learning. Most students (84%) disagreed that pronunciation learning is too difficult (Item 20), suggesting general confidence. However, concerns about pronunciation (Item 1) were mixed, with 33% neutral and nearly equal proportions agreeing (28%) and disagreeing (28%), indicating varied self-confidence. In Item 18, 61% of participants were satisfied with their effort, while 32% remained neutral, suggesting many feel confident but some are uncertain. Anxiety levels were moderate, as 53% strongly disagreed with feeling nervous in pronunciation class (Item 22), yet 42% expressed some level of nervousness. Pronunciation satisfaction (Item 21) showed 54% strongly disagreed that they will never feel satisfied, while 44% were neutral or agreed, reflecting optimism but lingering concerns. Lastly, Item 8 revealed 75% disagreed with feeling insecure speaking in front of classmates, but 18% strongly agreed, indicating a minority still struggles with pronunciation-related anxiety. Overall, students are generally motivated and confident, though some still experience pronunciation-related nervousness and self-doubt.

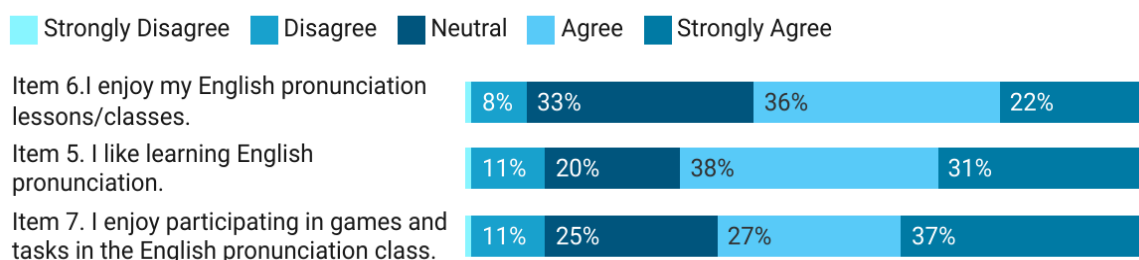


Figure 4. Positive Attitudes toward Pronunciation Learning

Figure 4 presents students' enjoyment of pronunciation learning. In Item 6, 58% of participants agreed or strongly agreed that they enjoy their pronunciation lessons, while 33% remained neutral and 8% strongly disagreed. This suggests that most students have a positive attitude toward their pronunciation classes, though some feel indifferent. In Item 5, 69% of students expressed liking English pronunciation, with only 11% strongly disagreeing. This indicates that pronunciation learning is generally well-received among students. Item 7, which focuses on enjoyment of interactive pronunciation activities, showed that 64% of students agreed or strongly agreed, while only 11% strongly disagreed. This suggests that games and tasks in pronunciation instruction are engaging for most students. Overall, the results indicate that students generally enjoy learning pronunciation, particularly when lessons involve interactive activities, though a small portion remains indifferent or disengaged.

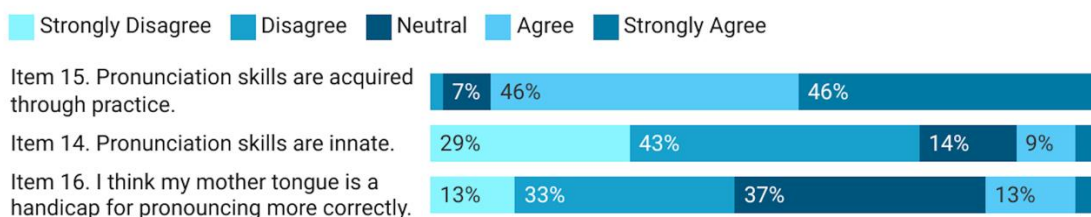


Figure 5. Beliefs about Pronunciation Learning

Figure 5 presents students' beliefs about pronunciation learning. In Item 15, 92% of students agreed or strongly agreed that pronunciation skills are acquired through practice, while only 7% strongly disagreed. This suggests that most learners view pronunciation as a trainable skill rather than an innate ability. Item 14, which examines the belief that pronunciation skills are innate, received mixed responses. While 29% strongly disagreed, 43% were neutral, and only 23% agreed or strongly agreed. The high percentage of neutral responses suggests uncertainty about whether pronunciation ability is natural or learned. Item 16, which concerns the perceived influence of one's mother tongue on pronunciation accuracy, showed that 50% of

students agreed or strongly agreed, while 46% disagreed or remained neutral. This indicates that while many students believe their native language affects their pronunciation, a significant portion does not see it as a major barrier. Overall, the findings suggest that students generally believe pronunciation is learned through practice, but some hold mixed views on whether it is an innate ability and how much their native language influences their pronunciation.

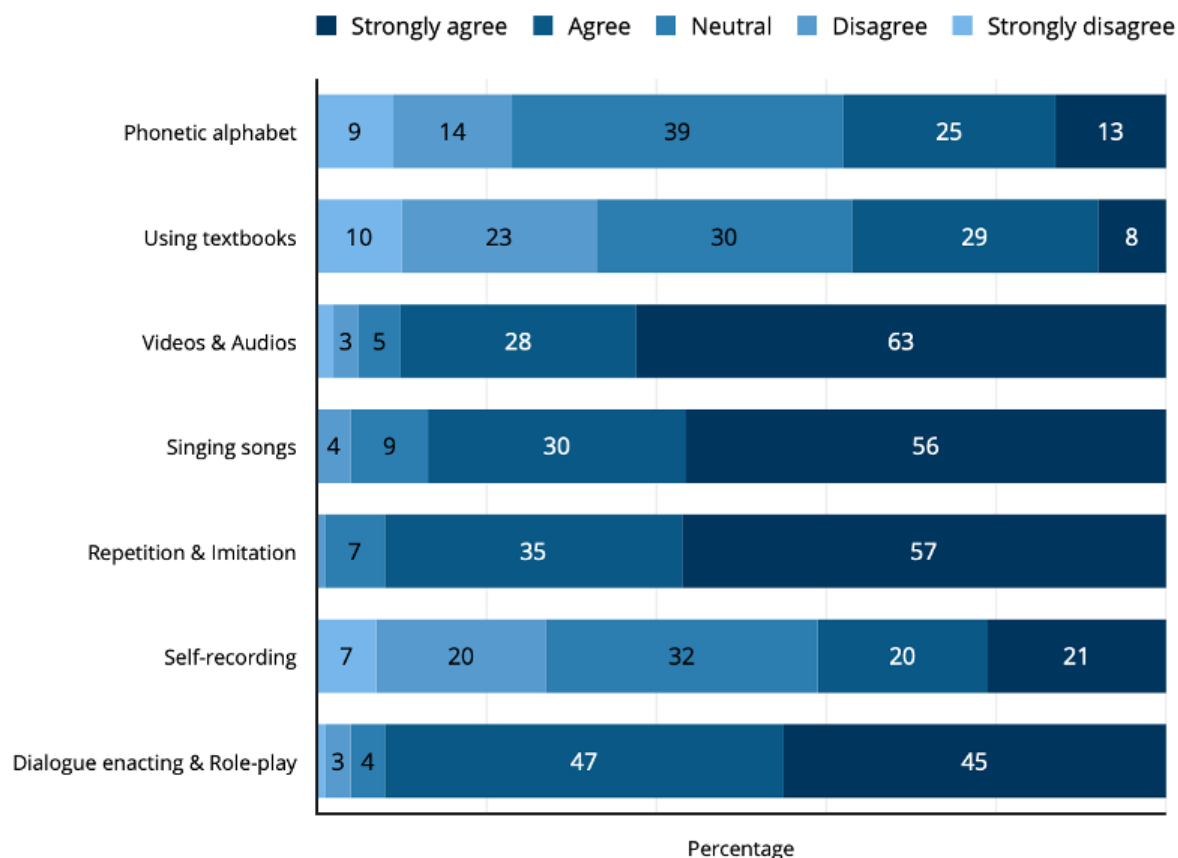


Figure 6. Pronunciation Improvement Technique and Activity Preferences

In the final part of the survey, the instructors answered the items that asked how useful they found specific pronunciation improvement techniques and activities. Judging from the mean scores and combined response percentages, using videos and audios ranked first ($M = 4.46$, $SD = .85$), followed closely by repetition & imitation ($M = 4.48$, $SD = .67$), singing songs ($M = 4.38$, $SD = .83$), and dialogue enacting & role-play ($M = 4.32$, $SD = .76$). On the other hand, participants found using textbooks as a resource for pronunciation learning to be the least helpful technique ($M = 3.02$, $SD = 1.11$), followed by learning & using the phonetic alphabet ($M = 3.18$, $SD = 1.10$) and recording their voice in English & listening to themselves ($M = 3.29$, $SD = 1.21$). In sum, survey responses indicate a strong preference for video and audio-based methods, repetition, and imitation for pronunciation improvement. Techniques such as using textbooks and learning the phonetic alphabet were perceived as less useful by participants.

Semi-Structured Questionnaire

This phase of the study involved data collection from 14 EFL instructors about which pronunciation practice the instructors deem the most and least effective including their underlying motives.

Table 1.

Pronunciation Improvement Techniques Rated by the Instructors

The most effective technique (Phonetic Alphabet)			The least effective technique (Using textbook)		
Theme	Codes	<i>f</i>	Theme	Codes	<i>f</i>
Foundational	Forms the basis of pronunciation	4	Ineffective assistance of pronunciation instruction	Being isolated Boring	2 2
Beneficial	Aids increasing accurate pronunciation	3	Mechanical Inauthentic		2 1

As for the most favorable technique, six instructors frequently reported that they apply the phonetic alphabet the most, followed by dialogue enacting & role-play ($f = 4$) and repetition & imitation ($f = 2$). The reasons behind their selection of the phonetic alphabet are outlined in P9:

Phonetic alphabet shows the basis for pronunciation and the sounds differ in English and this difference can be shown to the students with the help of this. After that, other techniques can be used but this alphabet is the key to form the basis.

In accordance with this response, P3 and P4 commonly mentioned that knowing the phonetic alphabet increases accurate pronunciation as people can pronounce even unfamiliar words accurately. Regarding role-plays (i.e., second most preferred technique), P1 said “since role-plays and dialogues include real-life communication, after listening to an authentic dialogue, students can imitate pronunciations of the words of English accents in role-plays.” and P5 said “while role-playing, students hear themselves and the others. They get feedback from me and their friends on their pronunciation too, so they try to be more careful with pronunciation. It is also more fun compared to other options.” Both excerpts illustrate how authenticity is favored by the surveyed language instructors.

As for the least effective technique and activity, analysis of the responses revealed that using textbook activities (e.g., repeating single sounds, identifying (un)stressed sounds, linking, and matching sounds with corresponding phonetic alphabet letters) ranked the first by five instructors. They used several negative adjectives for the use of textbooks such as they are isolated activities that bore students, mostly mechanical and away from being authentic. These codes collectively formed being ineffective theme in pronunciation instruction. To show an example that embraces most codes, P10 concluded “most textbooks are boring for students and the audio doesn’t sound authentic. They aren’t very engaging in terms of pronunciation practice. Students usually experience difficulties following and focusing on textbooks and sometimes do not find the activities of them meaningful.” Moreover, dialogue enacting & role-play technique was mentioned by three participants as the least effective technique for the students although the other participants mentioned it as a useful technique in their responses. For instance, P11 said this technique is particularly less useful for introverted students, P8 said students pay special attention to the completion of the task instead of their pronunciation and P6 does not believe its role in improving pronunciation.

All in all, the most effective technique the instructors found was the phonetic alphabet, due to its perceived effect of increasing accurate pronunciation and forming the foundation of pronunciation. This technique was followed by dialogue enacting and role-play techniques. However, the instructors’ overall tendency (35.71%) was not to find textbook activities as useful as the other techniques. The created theme for this technique was ineffectiveness, obtained by several negative codes in the responses.

Discussion and Conclusion

This study aimed to investigate learners’ and instructors’ views and in-class pronunciation instruction practices. The findings revealed students’ positive feelings and viewpoints about pronunciation learning, though some students expressed anxiety and insecurity about their pronunciation skills.

Additionally, there were mismatches between what learners found effective in improving their pronunciation in L2 (i.e., audio-visual content and repetition) and what instructors reckon as useful in-class pronunciation activities and techniques (i.e., phonetic alphabet and dialogue enacting). Concerning learners' views and feelings, our findings did not align with some studies in the literature. For instance, once compared with Edo-Marzá (2014)'s findings, fewer students in our study believed in pronunciation's importance in their lives. However, while Edo-Marzá's participants expressed strong enthusiasm for pronunciation tasks, a notable portion of students in this study remained neutral about their engagement with pronunciation activities. These differences might stem from students' future professional necessities in that only a limited number of students will be required to use professional English in our participant group. In addition, the educational background of the students can be influential as students in that study had an introductory course dedicated to phonetics and phonology and had more opportunities to practice pronunciation, unlike a huge majority of our participants. In comparison with other available research, it was found by Pawlak et al. (2015) that most of the participants reported liking learning English pronunciation. Our study similarly showed that students generally enjoy pronunciation learning and in-class pronunciation activities. However, some students experience pronunciation-related anxiety and insecurity, which may influence their engagement. This could explain why some participants felt uncertain about their pronunciation progress, despite their general enjoyment of pronunciation learning. In agreement with several research studies carried out by Monika et al. (2019), Nguyen et al. (2021), and Xuyen (2019), learners in our study believe in the importance of pronunciation for clearer communication and have positive feelings. Our results further indicate that while most learners see pronunciation as important, they also differ in their confidence and satisfaction with their pronunciation skills. Some students, particularly those who feel insecure speaking in front of classmates, may require additional support to overcome pronunciation anxiety.

As for pronunciation improvement techniques and activities, both in our study and in Edo-Marzá (2014), very few students found written coursebook exercises useful, unlike their instructors' beliefs. This finding might also reflect the way that instructors implement those textbook drills (e.g., pointing out stress in words, repeating whole sentences), which can be perceived as dull by the students, no matter how forced the instructors feel to fulfill curricular requirements. Next, the findings of this study provided support to Kusz and Pawliszko (2022), who reported that listening to recordings from textbooks was the top preference of the students. Similarly, the participants of this study mentioned the effectiveness of audio-visual materials in pronunciation instruction in the first place as well. This could be attributed to the notion that most Gen-Z learners are extensively exposed to audio-visual content through technological devices and this may potentially shape their preferences. In fact, the visual part of the option might have attracted the students' attention more. There was a mismatch regarding the use of repetition in that while students preferred it as an effective activity, it ranked as one of the least favored activities on the instructors' side. One possible interpretation of this finding can be that instructors might consider that solely repeating words or phrases does not lead to meaningful pronunciation skill improvement, but for learners, it requires minimum effort with maximum gain.

Digging deeper into instructors' practices of pronunciation instruction, this study noted that the findings about the most and least effective techniques for students corroborate the findings of some of the previous work. For instance, in both Alsofyani and Algethami (2017) and Buss (2015), the participant instructors favored the implementation of the phonetic alphabet usage over other techniques, which seems to be consistent with this research. The ease of pronouncing even unfamiliar words with the help of symbols and their pedagogical knowledge about the significance of phonetic alphabet instruction might play a key role in their choices. Besides, incorporating the phonetic alphabet into language instruction may not only aid in accurate pronunciation but also cultivate a deeper understanding of linguistic structures and enhance overall communication skills. Its systematic approach to representing sounds might provide learners with a powerful tool for mastering pronunciation, thereby fostering confidence and fluency in speaking. However, the majority of existing studies indicated a preference for repetition over other activities (Wahid & Sulong, 2013; Yulia & Saukah, 2021). The preference for repetition can be interpreted under the assumption that learners can practice intonation, rhythm, and stress simultaneously, ensuring that all learners practice

effortlessly. By repeating phrases or sentences, students can not only reinforce their understanding of the language but also fine-tune their pronunciation and prosody. In contrast, Jafari et al. (2021) found that drama and role-play were preferred by their participants, contradicting the findings of the present paper. The reason might be that the phonetic alphabet might seem harder to teach than wanting the learners to repeat and this can influence the teachers' practices. A further point to consider is students' beliefs about pronunciation learning itself. The majority of participants in this study agreed that pronunciation is learned through practice, rather than being an innate ability. However, some students remained neutral or even expressed agreement with the idea that pronunciation skills are innate, which suggests that learners differ in their fundamental perspectives on pronunciation acquisition. Similarly, many students believed their mother tongue influences their pronunciation ability, but opinions on whether it presents a true handicap were mixed. These varying beliefs may impact students' motivation and learning strategies in pronunciation instruction. The difference between the effectiveness of pronunciation techniques perceived by students and the beliefs held by instructors is apparent. Our interpretation is that the techniques preferred by students are those that do not require effort or burden from their perspective. It is expected for students to opt for the easier option, although it remains unclear whether their decisions are made consciously. What teachers find effective, on the other hand, are techniques that involve the necessary sound and symbol perception for pronunciation instruction and support meaningful communication through dialogue, role-play, and similar activities. They seem to emphasize pronunciation as part of meaningful communication within the context, considering their pedagogical knowledge and teaching experience. This is because learning in isolation may negatively affect communicative skills because they cannot use them. This disconnect could lead to reduced enthusiasm among learners for pronunciation learning and a lack of emphasis on teaching this language aspect by educators. Nonetheless, it might be plausible to meet on a common ground that benefits both sides in in-class activities through communication.

To conclude, this study aimed to explore the perspectives of tertiary-level EFL learners and instructors on pronunciation instruction and learning, prompted by the observation that pronunciation instruction is often neglected. Our main finding revealed a significant difference between learners' and instructors' preferences regarding effective pronunciation improvement techniques and activities. While learners favored listening to audiovisual materials, repetition, and singing songs, instructors leaned towards working on the phonetic alphabet and dialogue enactment and role-play, highlighting an incongruency between the two groups. Beyond technique preferences, the findings also highlight that while many students enjoy pronunciation learning, some experience anxiety and insecurity, which may influence their motivation. Addressing both technique preferences and emotional barriers could lead to more effective pronunciation instruction. These findings contribute to addressing existing knowledge gaps and stress the need for a rigorous understanding of the interplay between learners' views, instructional practices, and contextual factors influencing pronunciation learning in EFL settings.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

Author Contributions: Conceptualization, methodology, project administration and resources were shared by Mehmet Gazan and Nurdan Gürbüz. Data curation, formal analysis, investigation, visualization, writing - original draft, software and validation were carried out by Mehmet Gazan. Meanwhile, writing - review & editing and Supervision were handled by Nurdan Gürbüz.

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Appendices

Appendix 1. Learners' Survey

Part 1. Background Questions

1. How long have you studied English? (write in years_____)
2. Have you ever studied pronunciation in your previous education? (Yes/No)
3. How do you rate your own skills in English pronunciation from 1 to 10? ____/10
4. Your gender: F / M / Prefer not to claim Your age:_____

Part 2. Student Beliefs and Opinions Scale (Pawlak et al., 2015)

Item	Statement
1.	I am concerned about my pronunciation.
2.	I consider "English comprehension and pronunciation" an important subject.
3.	I consider pronunciation a key aspect for communication.
4.	I think English pronunciation is important for my professional future.
5.	I like learning English pronunciation.
6.	I enjoy my English pronunciation lessons/classes.
7.	I enjoy participating in games and tasks in the English pronunciation class.
8.	I feel insecure when I have to speak in English in front of my classmates.
9.	I could do much better when I speak in English in front of my classmates but I feel ashamed and insecure so I deliberately avoid sounding too native-like.
10.	I want to be able to pronounce English just like native speakers.
11.	It is very frustrating not be able to sound as an English native.
12.	I am satisfied with my pronunciation in English.
13.	If I have a good pronunciation, then I will feel more confident in English.
14.	Pronunciation skills are innate.
15.	Pronunciation skills are acquired through practice.
16.	I think my mother tongue is a handicap for pronouncing more correctly.
17.	Knowing the main theoretical rules of phonetics and phonology does not guarantee a good pronunciation.
18.	I am satisfied with the effort I devote to improve my pronunciation.
19.	It is frustrating to see how some classmates have much better pronunciation than me.
20.	I feel that learning English pronunciation correctly is too difficult for me.
21.	I think I will never feel satisfied with my pronunciation.
22.	I feel nervous in my English pronunciation class.

Part 3. Pronunciation Improvement Technique Preferences

Item	Statement
23.	I think pronunciation symbols (phonetic alphabet) are useful for learning pronunciation correctly.
24.	I think English textbooks can help me to learn English pronunciation.
25.	I think English videos and audios can help me to learn English pronunciation.
26.	I think that singing songs in English can improve my pronunciation.
27.	I think that repetition and imitation are important aspects to learn English pronunciation.
28.	I think that recording myself is useful to improve my pronunciation.
29.	I find dialogue enacting and role-play exercises useful.

Appendix 2. Teachers' Pronunciation Practices Questionnaire Items

1. Please rank the following pronunciation improvement techniques in order of effectiveness for students—1 being the most effective for you.

- ___ Pronunciation symbols (phonetic alphabet)
- ___ English textbook activities and exercises
- ___ Use of audiovisual materials
- ___ Singing songs
- ___ Repetition and imitation
- ___ Recording & listening (i.e., students record & listen to themselves)
- ___ Dialogue enacting and role-play

2. Why do you think your first pronunciation improvement technique is the most effective for students?

3. Why do you think your last pronunciation improvement technique is the least effective for students?

Determination of Teachers' Views on the Use of Assistive Technology in Special Education Classrooms¹

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Abstract

The use of assistive technologies in the education of individuals with special needs is rapidly increasing with advancements in technology, creating a greater demand for such tools in special education processes. At this juncture, the implementation of assistive technology, along with the experiences and competencies of teachers working in special education, is of paramount importance. This study aims to determine the opinions of teachers working in special education classes, special education work and practice centers, and special education vocational training centers in primary and secondary schools affiliated with the Ministry of National Education in Ankara and Eskişehir provinces. Four hundred fourteen special education teachers participated in the study. The descriptive survey model, which is appropriate for the study, was used. The data collection tool was the Assistive Technology Use Questionnaire developed by the researcher. The data were statistically analyzed, and frequency and percentage distributions were calculated. In analyzing the research data, the Chi-Square test, one of the non-parametric tests, was used in line with the objectives. The study's findings indicate that teachers' opinions on certain subtopics of assistive technology use varied significantly based on factors such as gender, educational status, teaching environment, prior assistive technology education during undergraduate studies, interest in internet and computer technologies, participation in assistive technology training, and personal use of assistive technologies. A majority of teachers reported feeling incompetent in using assistive technologies. The most commonly used and valued devices were smartphones, tablets, smart boards, and laptops. Based on these findings, integrating structured assistive technology training into teacher education programs and providing ongoing professional development opportunities could enhance teachers' competence and confidence in utilizing these technologies effectively. Keywords: Assistive technologies, individuals with special needs, teachers' opinions.

Keywords: Assistive technologies, Individuals with special needs, Teachers' views

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Introduction

In recent years, the rapid advancement of technology has driven a significant expansion in the range of tools and equipment utilized across various fields, underscoring the increasing reliance on digital innovations. In addition to the diversity of the areas of use of technology, the need to classify the technological equipment used in special education has arisen due to the differentiation of the needs of individuals with special needs (Edyburn, 2005). In this context, Blackhurst (2005) categorized the technologies used in special education into six categories: "medical technology, assistive technology, instructional technology, production technology, information technology, and teaching technology."

Assistive technology refers to the adaptation of technology to address the specific needs arising from a student's disability, enabling accessibility and support. In contrast, instructional technology encompasses the use of technology without modifications to enhance the knowledge and skills of students with special needs in a given subject (Pedrotty-Bryant & Bryant, 2012). Assistive technologies are tools or systems adapted to improve the quality of life by improving the competencies of individuals with special needs (Lancioni et al., 2013). In other words, assistive technologies are tools and equipment used to reduce the difficulties that individuals with special needs may encounter and to facilitate their participation in activities (Hersh & Johnson, 2008; Pettersson & Fahlstrom, 2010). Assistive technologies have benefits such as increasing motivation, supporting learning strategies and skills, providing more effective study and learning strategies, increasing individuals' socialization skills, supporting effective and independent practice, and providing independent and rapid feedback (Green, 2011).

Technology plays a crucial role in the education of individuals with special needs, who differ from their typically developing peers in learning characteristics, by facilitating the concretization of abstract concepts to enhance comprehension and accessibility. The technology used in special education contributes to equality of opportunity by supporting individuals' disabilities and improving their quality of life. In the education of individuals with typical development, technology primarily functions as instructional technology, serving as a tool to support the achievement of predefined instructional objectives (Edyburn, 2005; Sola-Özgüç, 2015). However, in the education of students with special needs, technology encompasses assistive technologies, which are specifically designed to bridge gaps in the individual's interaction with their environment, thereby mitigating functional limitations (Pedrotty-Bryant & Bryant, 2012; Sola-Özgüç, 2015). Assistive technology is one of the important elements in the individualized education program prepared for the student. In order to be used effectively and efficiently, assistive technologies should be clearly stated in the following definitions in the individualized education program: (1) in the definition of specially planned instruction, (2) in the definition of additional supports to be provided to the student, (3) in the definition of related services. Within the framework of specially planned instruction, assistive technology should be regarded as a means to facilitate learning rather than an end in itself, ensuring that its integration serves pedagogical objectives rather than merely fulfilling technological inclusion. Assistive technology should be used to help the student achieve the goal. Assistive technology should be utilized at all teaching stages (instruction, method, etc.) and include the provision, development, placement, adaptation for teaching, and training of practitioners through related services (Dell, Newton, & Petroff, 2012). Within the scope of this study, the use of technology by teachers working in special education or working with children with special needs was examined, and teachers' opinions were included.

A review of the literature reveals that the number of international studies significantly surpasses that of national studies. However, recent research has demonstrated increased diversification and momentum, reflecting a growing academic interest in the field. Ofiesh et al. (2002) examined assistive technology services provided to students with special needs. Alobiedat (2005) compared technology skills and technology standards of special education teachers. Sigafoss (2011) examined the use of technology in the educational process of students with severe disabilities. Fichten, Asuncion, and Scapin (2014) examined the relationship between digital technology and the learning of individuals with special needs. Narayan and Surabian (2014) planned research to determine the necessary activities to prepare teachers for using assistive technology. Wong and Cohen (2015) examined teachers' difficulties using assistive technology when working with visually impaired students in Singapore. In addition to these studies, there is a body of research that specifically explores the perspectives and recommendations of special

education teachers regarding the use of assistive technology (Alhossein & Aldawood, 2017; Alammery, Al-Haiki, & Al-Muqahwi, 2017; Alper & Raharinirina, 2006; Chimiliar, 2007; Sydeski, 2013), contributing to the discourse on educator perceptions and practical implementation."When the studies conducted in Türkiye are examined, it becomes evident that research on the opinions and attitudes of special education teachers toward the use of assistive technology remains limited, highlighting a gap in the national literature (Alammery, Al-Haiki, & Al-Muqahwi, 2017; Aslan, 2018; Bahçeci, 2019; Chmiliar, 2007; Çay, Yıkılmış, & Özgüç, 2020; Deniz & Demirkıran, 2006; Doğan & Akdemir, 2015; Kışla, 2008, 2011; Kutlu et al., 2019; Schreglmann & Cinisli, 2018; Sola-Özgüç & Cavkaytar, 2013; Sola-Özgüç & Cavkaytar, 2014; Sydeski, 2013; Tekinarslan & Yıkılmış, 2005). While some of the studies draw a general framework about universal designs and the use of assistive technology in education, some studies are on the processes of students' and teachers' use of assistive technology. When the research findings were analyzed, it was revealed that assistive technology effectively affects students' learning levels. On the other hand, teachers had budgetary problems accessing assistive technology, needed technical support, had problems with information and equipment, and perceived themselves as inadequate in using assistive technology.

Ensuring that education is individualized according to learners' needs is just as crucial as the methods used to deliver it. Given that individuals with special needs require greater support than their typically developing peers in terms of accessibility, access to services, and personalized instruction, assistive technologies play a critical role in the field of special education (Green, 2011; Pedrotty-Bryant & Bryant, 2012; Lancioni et al., 2013). Teachers are expected to be equipped with technology literacy and integration in education to use technology in special education in a qualified way. The fact that the new generation of teachers has mastered technology in many aspects of teaching shows its impact in many areas, such as teaching, preparing materials, meeting the vital needs of students, and counseling families. As a legal justification for this effect, it is stated that one of the performance indicators in the sub-competency area of "Monitoring and Contributing to Professional Developments" in the Teacher Qualifications Book of the Ministry of National Education in our country is the utilization of information and communication technologies (MoNE, 2008). The teacher training standards of the Council for Exceptional Children (CEC) state that teachers should use instructional and assistive technologies to develop content and deliver instruction (CEC, 2012). As seen in the teacher competencies stated in both national and international literature, it is revealed that teachers' use of technology is important in improving the educational process and self-development and that assistive technology is professional competence. In this direction, the research emphasizes teacher and staff training on technology use (Dexter & Riedel, 2003; Kelly, 2009; Van Laarhoven & Conderman, 2011).

On the other hand, the literature indicates that teachers need support in technology integration in special education and that support should be provided (Acungil, 2014; Fichten et al., 2001; Naraian & Surabian, 2014; Van Laarhoven & Conderman, 2011; Sola-Özgüç, 2015), it emphasizes that before providing this support, teachers' technology usage status and what they need should be determined (Dexter & Riedel, 2003; Kahraman et al., 2005; Narayan & Surabian, 2014; Usluel et al., 2007; Van Laarhoven & Conderman, 2011; Staples & Edmister, 2014). It is thought that the current research will help to meet the needs in the applied field in terms of affecting the teaching and learning processes in the classroom environment. There is a need for information in the literature about technology use in schools in Turkey, how it is realized, what is needed, what the problems are, and solution suggestions. Since there is no study in Turkey in which the opinions of special education classroom teachers about technology are directly determined, it can be said that there is a need for such studies since determining the opinions of special education classroom teachers about assistive technology in the theoretical framework will contribute to the literature.

Purpose of the Study

1. The overarching aim of this study is to explore the opinions and recommendations of special education teachers working in special education classrooms, special education work and practice centers, and special education vocational training centers within primary and secondary schools affiliated with the Ministry of National Education in Ankara and Eskişehir. In alignment with this primary objective, the study seeks to address the following sub-objectivWhat are

special education teachers' opinions about using assistive technology in special education schools and special education classrooms?

2. What assistive technologies are used by special education teachers in special education schools and classrooms?
3. According to the demographic information of special education teachers, do their views on the use of assistive technology differ significantly according to (a) age, (b) gender, (c) duration of teaching, (d) educational status, (e) graduated program, (f) educational environment served, (g) level of education, (h) assistive technology training, (i) interest in internet and computer technology, (j) additional training, (k) use of technology while working with children with special needs?

Method

Research Model

This study employs a descriptive survey design, a widely used quantitative research method for gathering data on individuals' opinions, attitudes, and experiences. Given the study's objective of exploring the perspectives and recommendations of special education teachers regarding the use of assistive technology, a survey model was deemed appropriate. This design allows for the systematic collection of data from a large sample, facilitating the identification of trends, patterns, and differences based on demographic variables. Accordingly, the study was conducted in special education classrooms, work and practice centers, and vocational training centers within primary and secondary schools affiliated with the Ministry of National Education in Ankara and Eskişehir.

Population and Sample
The study group consisted of teachers working in primary, secondary, and special education practice centers, special education work practice centers, and vocational education centers in Turkey. In the 2015-2016 academic year, a total of 414 teachers working in primary schools, secondary schools, special education practice centers, special education job application centers, and vocational education centers affiliated with the Ministry of National Education in Eskişehir (26 schools) and Ankara (16 schools) participated in the study. These teachers had mainstreaming students in their general education classrooms. The participants in this study were selected using criterion sampling, a type of purposeful sampling, ensuring that individuals met specific predefined criteria relevant to the research objectives.. Purposive sampling is a type of sampling in which the researcher selects participants with specific characteristics according to the purpose of the research and can provide more support to the research problem (Patton, 2002). Criterion sampling, on the other hand, is a type of sampling in which the characteristics that are predetermined for the research and important for the research are determined as prerequisites, and the participants who meet all of these characteristics are selected (Yıldırım & Şimşek, 2013).

Ethical approval for the research was obtained from the Eskişehir Anadolu University Scientific Research and Publication Ethics Committees. In addition, consent was obtained from the participants, indicating that they voluntarily participated in the research before participating, that they could leave it whenever they wanted, and that all data would be kept confidential during and after the research.

According to the research findings, 414 people participated in the study; 315 (76.1%) were female, and 99 (23.9%) were male. When the age ranges of the participants are analyzed, it can be said that there are 48 (11.6%) in the 20-24 age range, 99 (23.9%) in the 25-29 age range, 103 (24.8%) in the 30-34 age range, and 165 (39.8%) in the 35 and over age range. When the programs that the participants graduated from are examined, it is seen that 251 (60.9%) of the participants graduated from other non-field teaching programs. Regarding the training on assistive technologies during undergraduate education, 270 (65.2%) did not receive any training, while 308 (74.4%) teachers did not receive any training on using assistive technologies.

Data Collection

The study gathered data to identify participants' characteristics and examine the use of assistive technology in lessons by special education classroom teachers. To achieve this objective, data were collected using the "Assistive Technology Use Questionnaire," developed by the researcher and

administered to teachers working in primary schools, secondary schools, special education practice centers, special education work practice centers, and vocational education centers. Data Collection Tool and Development

In the research process "Assistive Technology Use Questionnaire" was developed by the researcher following the questionnaire development process of Büyüköztürk et al. (2013) to determine the opinions of teachers working in special education classes, special education work, practice schools, and special education vocational training schools in primary and secondary schools affiliated to the Ministry of National Education in Eskişehir and Ankara in the 2015-2016 academic year.

In this study, the questionnaire development process involved reviewing the literature on special education and teachers' use of assistive technology, followed by structuring and planning the questionnaire design to ensure its alignment with the research objectives. First, the questionnaire items and questions based on the literature were written. Then, these items' and questions' content and face validity were evaluated. The questionnaire items created by the researcher were sent to 10 experts in the field, and their opinions were obtained. The questionnaire, which was revised in line with these opinions, was applied as a pre-application to five research assistants who had previously worked as special education teachers in special education schools affiliated with the Ministry of National Education at Anadolu University Faculty of Education, Department of Special Education. The results of this application were analyzed, and it was decided that the items worked and were appropriate. Content validity, one of the validity types, was examined for all items of our questionnaire. For this purpose, the questionnaire items created by the researcher in the current study were sent to 10 field experts for their opinions. The questionnaire was self-administered and distributed to schools within the scope of the study during the 2015-2016 academic year. The researcher personally delivered the questionnaires, provided the necessary explanations, and requested participants to complete them independent.

Data Analysis

Before data analysis, the dataset was first examined for missing values. The responses of 12 participants who left a significant portion of the items unanswered in any of the data collection tools and three participants who provided incorrect coding were excluded from the analysis. Thus, the number of participants decreased from 431 to 414. Since the study group was large and the missing values were less than 5% (Tabachnick & Fidell, 2007), the other items with missing data were assigned values using the average assignment method.

Secondly, one-way extreme value analysis was performed for all variables in the study to evaluate whether participants had extreme values. For this purpose, all scores in the distribution were converted into standard z scores (Çokluk, Şekercioğlu, & Büyüköztürk, 2012). The data of 2 participants with z values more significant than +3.29 and less than -3.29 (Tabachnick & Fidell, 2007) were excluded from the analysis, and the procedures were carried out on 414 participants.

The data collected through the questionnaires were first analyzed descriptively by calculating frequencies (f) and percentages (%) for variables such as age, gender, duration of teaching in special education, educational status, graduated program, educational environment and level served, as well as teachers' opinions on the use of assistive technology and the types of assistive technologies they utilized. Then, whether there is a significant difference between the utilization of assistive technologies according to these variables was analyzed with the Chi-Square test (Chi-Square) through SPSS. The significance level was taken as 0.05.

Findings

The frequency and percentage distributions of the data obtained from the data collection tool used in the study and the findings obtained as a result of statistical analysis of the data are presented in Table 1. As seen in Table 1, the study participants comprised 414 people, 315 (76.1%) of whom were female and 99 (23.9%) male. When the age variables of the participants are examined, it is seen that there are 48 (11.6%) people between the ages of 20-24, 99 (23.9%) between the ages of 25-29, 103 (24.8%) between the ages of 30-34, and 165 (39.8%) between the ages of 35 and above. Looking at the undergraduate programs that the participants graduated from, 161 (39.1%) participants graduated from special education teaching programs, and 251 (60.9%) participants graduated from other non-field teaching programs. When we look at the status of receiving training on assistive technologies during

undergraduate education, it is seen that 270 (65.2%) did not receive any training. In comparison, 308 (74.4%) teachers did not receive any training on using assistive technology.

Table 1.

Findings Related to Personal Information

		N	Percentage (%)
Age	20-24	48	11,6
	25-29	99	23,9
	30-34	103	24,8
	35 and above	165	39,8
Gender	Woman	315	76,1
	Male	99	23,9
Special education teaching time	0-5	239	57,9
	6 and above	174	42,1
Education Status	Associate degree	13	3,1
	License	370	89,2
	Master's degree	31	7,5
	PhD	1	0,2
Graduated program	Teaching the mentally handicapped	161	39,1
	Other teaching positions	251	60,9
Educational environment served	Special education class	134	32,3
	Vocational training center	37	8,8
	Application center	243	58,6
Education level served	Tier I	126	30,5
	Tier II	152	36,8
	Tier III	135	32,7
Receiving training on assistive technologies during undergraduate education	Yes	140	33,8
	No.	270	65,2
Being interested in Internet and computer technologies	I am interested	224	54,1
	Partially interested	181	43,7
	No interest	8	1,9
Participation in training on the use of assistive technology	Yes	99	23,9
	No.	308	74,4
Utilization of assistive technologies when working with individuals with special needs	Yes	296	71,5
	No.	112	27,1

As seen in Table 2, 42.8% of the participants use smart boards, 31.2% use tablet computers, 65.7% use smartphones, 47.6% use laptops, 10.1% use voice recorders, and 21.0% use other devices. It is seen that the first three devices that teachers use the most are smartphones, laptops, and smart boards, respectively. When we look at which problems teachers experience during the use of assistive technology, it is seen that 49.5% of the participants chose the option "I have trouble accessing," and 32.4% chose the option "I cannot get technical support." It is seen that the first three problems

experienced by teachers during the use of assistive technology are having difficulties in accessing, not getting technical support, and not having enough information, respectively.

According to Table 2, when teachers' purposes of using assistive technologies are evaluated, 85.3% of the participants marked the option of providing motivation, and 89.2% marked the option of performing the skill or behavior more quickly and fun. The first three purposes of teachers' use of assistive technology are to perform the skill or behavior more quickly and fun, to provide motivation, and to provide more effective learning strategies.

Table 2.
Findings Related to Assistive Technologies Used by Teachers

	Assistive Technologies	<i>f</i>	%
Assistive technologies used by teachers in their classrooms	Smartboard	177	42.8
	Tablet computer	129	31.2
	Smartphone	272	65.7
	Laptop computer	197	47.6
	Voice recorder	42	10.1
	Other	87	21.0
Assistive technologies that teachers find useful	Smartboard	330	79.7
	Tablet computer	253	61.1
	Smartphone	159	38.4
	Laptop computer	210	50.7
	Voice recorder	50	12.1
	Other	33	8.0
Teachers' purposes of using assistive technology	Saving time	223	53.9
	Providing motivation	353	85.3
	Performing the skill or behavior more easily and enjoyably	365	89.2
	Enabling easy control of the skill or behavior	126	30.4
	Facilitate the collection of data and information about the student's learning level	166	40.1
	Providing more effective learning strategies	280	67.6
	Providing opportunities to increase interaction between students in the classroom	130	31.4
	Encouraging students to practice independently	174	42.0
	Enabling students to do activities independently and providing immediate feedback	168	40.6
	Other	10	2.4
Sources that teachers use to obtain information about assistive technologies	I do not receive the information	14	3.4
	Textbooks	71	17.1
	Scientific journals	62	15.0
	From their website	351	84.8
	Television	50	12.1
	From my social circle	223	53.9
	Social media	154	37.2
	Other	19	4.6

Table 2 continuing

Which problems do teachers experience	I do not have enough information	107	25.8
	I do not know how to use it	37	8.9
	I have problems with transportation	205	49.5
	I need the support of experts for its use in the classroom	96	23.2
	I cannot get technical support	134	32.4
	Other	36	8.7

According to Table 3, the gender variable of the teachers participating in the study shows a significant difference in knowledge about assistive technologies and their use. Male teachers in the study have higher averages than female teachers.

There is no statistically significant difference between the opinions of the teachers participating in the study regarding the use of assistive technology according to the variable of special education teaching time.

When the opinions of the teachers about knowing the use of assistive technology were analyzed according to the teaching time variable, 8.5% of those who have been teaching in the field of special education for 0-5 years strongly agree, 52.5% agree, 9.2% of those who have been teaching in the field of special education for 6 years or more strongly agree, 43.4% agree. It was concluded that the level of agreement or disagreement of teachers on the topic of knowing the use of assistive technology did not show a significant difference according to the duration of teaching special education.

Table 3.

Comparison of Teachers' Views on the Use of Assistive Technology According to Gender

		Gender						χ^2	Sd	p
		Woman		Male		Total				
		N	%	n	%	N	%			
Knowing assistive technologies	Agree	23	7.3	20	20.2	43	10.4	15.69	4	.003*
	I agree.	153	48.6	46	46.5	199	48.1			
	Undecided	82	26.0	22	22.2	104	25.1			
	Disagree	49	15.6	8	8.1	57	13.8			
	Strongly disagree	8	2.5	3	3.0	11	2.7			
Assistive technology on the use of having knowledge	Agree	18	5.8	19	19.2	37	9.0	19.76	4	.001*
	I agree.	153	49.0	47	47.5	200	48.7			
	Undecided	65	20.8	18	18.2	83	20.2			
	Disagree	70	22.4	12	12.1	82	20.0			
	Strongly disagree	6	1.9	3	3.0	9	2.2			

According to Table 4, the teachers participating in the study's variable related to the internet and computer technologies show a significant difference in their knowledge about assistive technologies, their use, ability to choose appropriate assistive technologies for students, and accessibility to assistive technologies.

Table 4.

Comparison of Teachers' Opinions on the Use of Assistive Technology According to Being Interested in Internet and Computer Technologies

		Relevance to Internet and Computer Technologies								
		I am interested		*Other		Total		χ^2	Sd	p
		n	%	n	%	N	%			
Knowing assistive technologies	Agree	39	17.4	4	2.1	43	10.4			
	I agree.	125	55.8	73	38.6	198	47.9			
	Undecided	43	19.2	61	32.3	104	25.2	59.75	4	.000*
	Disagree	14	6.2	43	22.8	57	13.8			
	Strongly disagree	3	1.3	8	4.2	11	2.7			
Assistive technology on the use of having knowledge	Agree	32	14.4	5	2.7	37	9.0			
	I agree.	120	54.1	79	42.0	199	48.5			
	Undecided	37	16.7	46	24.5	83	20.2	34.19	4	.000*
	Disagree	31	14.0	51	27.1	82	20.0			
	Strongly disagree	2	0.9	7	3.7	9	2.2			
Suitable for the student assistive technologies be able to choose	Agree	30	13.5	8	4.3	38	9.2			
	I agree.	125	56.1	93	49.5	218	53.0			
	Undecided	42	18.8	52	27.7	94	22.9	21.83	4	.000*
	Disagree	26	11.7	29	15.4	55	13.4			
	Strongly disagree	0	0.0	6	3.2	6	1.5			
Assistive technologies accessibility	Agree	17	7.6	11	5.9	28	6.8			
	I agree.	101	45.3	55	29.3	156	38.0			
	Undecided	34	15.2	43	22.9	77	18.7	15.53	4	.004*
	Disagree	58	26.0	71	37.8	129	31.4			
	Strongly disagree	13	5.8	8	4.3	21	5.1			

Discussion, Conclusion, and Recommendations

The findings derived from special education teachers' perspectives on the use of assistive technology in special education schools and classrooms indicate that the most frequently selected response across all topics was 'agree.' This suggests that teachers generally perceive themselves as competent in understanding assistive technologies, utilizing them effectively, selecting appropriate tools for students, and accessing them. They think that assistive technologies increase the speed and motivation of students. This finding supports the research findings in the literature (Alkahtani, 2013; Çağıltay & Çakıroğlu, 2001; Kahraman, Köse, & Kara, 2005; Smith & Kelley, 2007; Tınmaz, 2004). However, there are different results in some studies in the literature. According to the results of these studies, it has been revealed that special education teachers are not confident in using assistive technology and need information and training in this field (Alkahtani, 2013; Ashton et al, 2005; Kutlu, Schreglmann, & Cinisli, 2018; Sakallı Demirok, Haksız, & Nuri, 2019; Smith & Kelley, 2007; Wilcox et al, 2006). The reason for such a difference may be because our study classified assistive technologies separately as

low-level, medium-level, and high-level technology tools and asked about the tools in each class separately.

An analysis of the findings regarding the assistive technologies used by special education teachers in special education schools and classrooms reveals that the three most frequently used devices are smartphones, laptops, and smart boards, respectively. Similarly, the three devices perceived as most useful by teachers are smart boards, tablet computers, and laptops. However, in contrast to these findings, Kutlu, Schreglmann, and Cinisli (2018) reported that teachers either do not use high-level assistive technologies or only use them a few times per week. Additionally, the primary purposes of using assistive technology were identified as enhancing skill or behavior performance in a more efficient and engaging manner, increasing motivation, and facilitating more effective learning strategies (Alper & Raharinirina, 2006; Edyburn, 2001). Teachers' first three sources to get information about assistive technologies are the website, social environment, and social media. The first three situations that affect teachers' decision-making processes when using assistive technology are, respectively, student needs, the subject to be taught, and the assistive technologies available in the school, and the first three problems teachers experience during the use of assistive technology are; access, lack of technical support, and lack of sufficient knowledge, and these findings are broadly consistent with the literature (Alammary, Al-Haiki, & Al-Muqahwi, 2017; Alkahtani, 2013; Alper & raharinirina, 2006; Ok & Bryant, 2012; Sydeski, 2013). Kutlu, Schreglmann, and Cinisli (2018) identified the most significant barriers faced by teachers in using assistive technology as the high cost of tools and equipment, software complexity, the lack of assistive technology in classrooms, and insufficient technical support. The findings of this study align with previous research in the literature, which similarly highlights these challenges as key obstacles to the effective use of assistive technology in education (Haiki & Al-Muqahwi, 2017; Alkahtani, 2013; Bryant, Seok, Ok, & Bryant, 2012; Sydeski, 2013). This study examined the perspectives of special education classroom teachers on the use of assistive technology. However, it did not investigate the use of assistive technology across different disability groups. A review of the literature reveals that previous studies have focused on various disability groups, including individuals with intellectual disabilities (Mechling & O'Brien, 2010; Acungil, 2014; Sola-Özgüç, 2015), individuals with diverse disabilities (Scott, McGuire, & Foley, 2003), individuals with severe developmental disabilities (Lancioni, Hof, Boelens, Rocha, & Seedhouse, 1998; Sigafoss, 2011), and individuals with visual impairments (Kelly, 2009; Wong & Cohen, 2010). It is also stated that assistive technology is mainly utilized in teaching individuals with visual and hearing impairments (Ofiesh et al., 2002). In the study conducted by Ofiesh et al. (2002), it is stated that the group in which assistive technologies are least utilized in teaching is individuals with psychiatric and other health problems.

The analysis revealed no statistically significant difference in teachers' opinions on the use of assistive technology based on the variable of teaching duration in special education. Accordingly, it was concluded that the duration of special education teaching does not affect teachers' views on using assistive technology. Other studies indicate no relationship between professional experience and the use of assistive technology (Coleman et al., 2015). However, when the literature is examined, it is seen that there is a relationship between professional teaching time and internet use in Akkoyunlu's (2002) study examining teachers' internet use. As a result of the research, it was found that while the rate of internet use of teachers with 1 - 15 years of experience was higher, the rate of internet use of teachers with 16 and 20 years of experience was relatively low (5%) and teachers with more than 20 years of experience did not use the internet. This difference may be because the research in which Akkoyunlu reported his findings was conducted in 2002. With the increasing prevalence of technology, attitudes toward its use may have evolved over time, becoming less dependent on professional experience and age. Another possible explanation for the relationship between age, professional experience, and technology use is the variation in technology literacy levels across different age groups, as observed in Akkoyunlu's study. The study findings indicate that teachers identified the most significant challenges in technology use as limited access to assistive technology, lack of technical support, and insufficient knowledge about assistive technologies, respectively. These study findings are similar to those of other studies in the literature (Alkahtani, 2013; Kutlu, Schreglmann, & Cinisli, 2018; Smith & Kelley, 2007). In order for teachers to be able to use assistive technologies effectively in the education and training of students with special needs in order to reveal their existing performance in the best way possible by minimizing the disadvantages of the individual in the education and training of students with special needs, qualified

in-service training support can be provided to teachers, technology support staff can be provided in the school to support the teacher in the areas that the teacher will need, and online support can be provided by involving the teacher in technology.

The study findings reveal a significant difference in teachers' perspectives on the role of assistive technologies in enhancing student motivation and accessibility, based on whether they received training on assistive technologies during their undergraduate education. In their study, Dexter and Riedel (2003) examined the competencies of preservice teachers who took the "Technology for Teaching and Learning" course. The study's findings revealed that the students' competencies who took technology courses in their undergraduate education were high. In similar studies, it has been found that in programs that train teachers in the field of special education, presenting the teaching content with technology support increases preservice teachers' tendency to use assistive technology in their classrooms (Alkahtani, 2013; Chmiliar, 2007; Cole et al., 2002; Russel et al., 2003). Based on these findings, teachers must receive training on assistive technologies during their undergraduate education. Of the sources from which preservice teachers acquire technology use skills, 34% are faculty members at the university, 22% are academic advisors, 21% are faculty members with whom they are in contact, and 16% are different and multiple sources (Dexter & Riedel, 2003). These findings underscore the importance of special education teachers acquiring functional proficiency in the use of assistive technologies during their undergraduate education. The findings of this study highlight key challenges in the use of assistive technology in special education settings. The most significant issues identified in Türkiye are limited access to assistive technology and insufficient technical support, whereas in the international literature, particularly in developed countries, the primary concern is the lack of technical support. Despite these challenges, increasing the integration of assistive technologies in schools is essential to enable individuals with disabilities to maximize their potential and to enhance teachers' knowledge and skills in this area.

To improve the effective use of assistive technology in special education, support services should be developed to address teachers' needs related to the purposes, application, and accessibility of these technologies. Additionally, teachers' use of assistive technology should be monitored, and technical support personnel should be employed in schools to assist educators in overcoming practical difficulties.

A national literature review reveals the lack of a standardized scale for measuring teachers' use of assistive technology. Future studies could focus on developing such a scale by incorporating insights from international research and refining the questionnaire used in this study. Furthermore, an experimental study with a pre-test and post-test design could be conducted to assess the effectiveness of a training program on assistive technologies, covering their purposes, benefits, and available resources for preservice teachers. Additionally, while this study examined teachers' perspectives on existing assistive technologies, further research could explore technical challenges and difficulties in greater depth through a qualitative approach.

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Prospects and Prevalence of Higher Education Learning Technologies for Secondary Social Sciences Student-teachers in South Africa and Lesotho: A Comparative Study

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Abstract

The South African Development Community's educational framework for Higher Education emphasises the enhancement of learning technologies to ensure quality teaching and learning. This study seeks to compare the advancements in learning technologies within Higher Education in South Africa and Lesotho, specifically in social sciences education. One university from South African and one from Lesotho were purposefully selected for this comparative study. Adopting a pragmatic paradigm, the study prioritises the methods that best address the research questions, employing a qualitative approach. The primary participants were student-teachers, selected purposefully from each university. Data was gathered through interviews and analysed thematically. The findings reveal that in both countries, learning technologies serve various purposes, including providing learning resources, facilitating and assessing learning, promoting cooperative learning, enabling learning anywhere, and managing COVID-19 impacts. The available learning management systems at each university, Thuto (Lesotho) and eThuto (South Africa), are supported by devices such as computers and smartphones.

Keywords: Learning technologies, student-teachers, higher education, social sciences education.

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Introduction

In the context of the fourth industrial revolution, education remains fundamental to national development, facilitated through international treaties (Bukoye, 2019). Development encompasses improvements across social, political, economic, and environmental spheres. International organisations spearhead development through education, with Higher Education (HE) - studies at colleges and universities - being the most impactful. This level of education is pivotal as it produces experts, including future schoolteachers (Owate, 2018). The effectiveness of Higher Education Institutions (HEIs) is largely determined by the quality of their learning technologies (LTs), which are digital tools and resources for education (David & Vera, 2017).

In the Southern African region, HE is influenced by efforts from the African Union and the United Nations to promote programme comparability and harmonisation (Hoosen, Chetty & Butcher, 2018). The region has also established the Southern African Development Community (SADC), which, through its Protocol on Education and Training Policy (1997), aims to enhance the availability of LTs within HE (SADC, 1997). Mavimbema (2020) notes that the policy framework lasted until 2020. The conclusion of this framework necessitates a comparative investigation into HE across participating countries, with the scope determined by the researchers' resources. Both South Africa and Lesotho are SADC members and have committed to improving LTs in HE. This study focuses on Lesotho and its neighbour, South Africa, due to the proximity and affordability for the researcher based in Lesotho. In a Social Science education context, the authors aimed to compare similar programmes at universities in these two countries. Additionally, the study addresses a gap in comparative research between Lesotho and South Africa, despite their shared educational frameworks.

Social Sciences education – training on the socio-economic and political behaviour of societies (Salui and Odjugo, 2020) – applies in various levels in education system. In HE, Social Sciences education, initially, is a department which offers Social Sciences education programme for schoolteachers covering (but not limited to) Economics, History, Development Studies and Accounting (Central University of Technology (CUT), 2017; National University of Lesotho (NUL), 2024). In schools, it appears that South Africa and Lesotho offer Social Sciences education as a conglomerate and introduction of some subject specialisations beyond primary education (Department of Basic Education (DBE)-South Africa, 2011; Ministry of Education and Training (MoET)-Lesotho, 2008). The succeeding secondary education emerges as foundation to HE Social Sciences education subject specialisations (DBE, 2011; MoET, 2008). Within HE, student-teachers undertake training to serve in delivery of foundational Social Sciences education subject specialisations within secondary education (CUT, 2017; NUL, 2024). Precisely, they employ LTs in acquisition of knowledge on instructional design and content, and use of pedagogies for professional growth (Salui et al, 2020). At their tenure, Hao and Lee (2017) argue that Social Sciences teachers essentially suppose to integrate LTs in teaching-learning processes, which Salui et al. (2020) shortly illustrate as employing LTs in creation of interactive lessons and facilitation of active learning pedagogies. Enabling learners to use LTs, they take allegiance by equipping learners with operational skills owing to rich learning content on Social Sciences education in the 21st century (Salui et al, 2020).

The adoption of LTs in South Africa and Lesotho appears to have occurred at different times. Bagarukayo and Kalema (2015) note that several South African universities implemented LTs like WebCT LMS, Sakai, Vula, and Moodle between 1995 and 2010. In contrast, Mashinini (2020) reports that Lesotho's established learning management system, Thuto, was introduced in 2010 at one of its universities. This suggests that South Africa adopted LTs earlier than Lesotho, likely due to its stronger economic position.

This comparative literature highlights the general timeline of LTs adoption in South Africa and Lesotho but does not address the extent to which individual programmes have been supported or the impact these technologies have had. This study aims to fill that gap by focusing on Social Sciences education, specifically Development Studies Education (DSE) at a Lesotho university and Economics Education (EE) at a South African university. The researcher, a DSE specialist, selected EE as the most comparable subject when no direct equivalent to DSE was available. Both subjects include themes from Development Economics, making them suitable for comparison. The focus of this study is on the LTs

used in these subject areas, which are typically similar across Social Sciences education programmes at each institution.

Problem statement

The SADC has emphasised the importance of adequate LTs for effective education within HEIs (SADC, 1997). Social Sciences education programmes, like other disciplines, require sufficient LTs to effectively train competent student-teachers for secondary education. However, both South Africa and Lesotho face challenges in this regard, as noted by Mafenya (2014) and the Council on Higher Education-Lesotho (2013), which identified a scarcity of LTs readily available. This shortage hinders pedagogical approaches such as blended learning, which is highly motivational for students. Consequently, this study is interested in exploring how these countries have addressed the scarcity of LTs to improve learning outcomes in Social Sciences education programmes. The problem statement gives rise to the research questions and significance of the study.

Research questions

This paper aims to answer the following research questions:

- What is the purpose of learning technologies in Social Sciences education?
- How prevalent are learning technologies in Social Sciences education?

Significance of the study

The study explores the extent to which LTs in Social Sciences education have improved from 2014 to 2023. It also assesses the impact of the available LTs during this period. Based on the findings regarding the current state and effectiveness of LTs, the study offers recommendations for improving learning technology policy statements. Overall, the content of this study provides a foundation for other comparative studies within the SADC context.

Conceptual framework and related literature

The study is conceptually guided by the Technological, Pedagogic, and Content Knowledge (TPACK) model, which is important for quality learning and teaching in Social Sciences education (Colón, Rus, Moreno & Montoro, 2023). Within this model, the focus is on technological knowledge (TK), which refers to the understanding that lecturers and students have of how to use LTs (Adalar, 2021; Mishra & Keohler, 2006). The study investigates the availability of these technologies, as their use depends on their existence. Furthermore, it explores the significance of LTs in Social Sciences education from an ontological perspective.

LTs in Social Sciences education are essential from various perspectives. Ogbaji (2017) highlights that LTs are a vital source of information for learning. Cervino and Vera (2017) add that LTs facilitate learning by presenting information in multiple formats, including text, visuals, and audio. Yambi (2018) points out that LTs can also assess student-teachers through tests, quizzes, and examinations, providing prompt feedback (Mashau & Nyawo, 2021; Aina&Ogegbo, 2021). Furthermore, LTs enable student-teachers to engage in cohort-based learning. Cohort-based learning serves as a vital support for lecturers adapting to contemporary learning trends, methods, and challenges. It has emerged as a response to the evolving landscape of online education, promoting new principles and active learning. These principles emphasise that groups, rather than individuals, are the primary units of learning (Rawashdeh, Mohammed, Arab, Alara & Al-Rawashdeh, 2021). Whether learning individually or in groups, LTs allow education to occur anywhere (Fernandez-Batanero, Montenegro-Rueda, Fernandez-Cerero& Tadeu, 2022). Additionally, during the COVID-19 pandemic, LTs ensured that learning continued uninterrupted (Coman, Tîru, Mesesan-Schmitz, Stanciu&Bularca, 2020).

While LTs are prevalent in HEIs, their extent within Social Sciences education needs further clarification. In Nigeria, Jolaosho (2023) has identified LTs such as Virtual Reality and Google Classrooms used for EE lectures. The COVID-19 pandemic highlighted the importance of LTs, leading to widespread adoption across HEIs. Haththotuwa and Rupasinghe (2021) in Sri Lanka found that LTs are widely available and used extensively, with usage rates ranging from 50 to 70 percent. However, Adeyemi (2020) reported that the influence of lecturers on LT use was low due to a lack of incentives, resulting in limited utilization. In Turkey, Erdogan and Serefli (2021) identified complementary LTs including Twitter, Messenger, Facebook, Instagram, and WhatsApp.

In addition to lecture-based LTs, e-library technologies are becoming more prevalent as libraries transition from traditional operations (Owate, 2018). Mbambo-Thata (2021) noted the use of e-library resources such as Emerald, Ebscohost, Proquest, Dawsonera, and JSTOR, which provide access to e-books, e-journals, theses, dissertations, magazines, and newspapers. Onuoha and Mbama (2021) reported that the use of these resources in social sciences education is extremely high, ranging between 80 and 100 percent. HEIs typically provide desktops and smartboards for both lecturers and students at the university (Erdogan & Serefli, 2021), while students use personal devices like laptops, smartphones, tablets, and iPads (Salhab & Daher, 2023). SADC has emphasised the importance of adequate LTs for effective education.

Method

The study has adopted a research paradigm, which is defined as a framework that researchers agree upon as optimal for conducting scientific investigations (Perera, 2018). Specifically, it employs pragmatism - a paradigm that permits the use of elements from other paradigms such as positivism, interpretivism, and critical theory to address research problems (Cohen, Manion & Morrison, 2018). Pragmatism is particularly relevant because it enables the researcher to effectively address the study's questions (Perera, 2018).

The study employs a qualitative approach, which is pertinent for gaining a deep understanding of phenomena, exploring human experiences, and developing new insights and theories (Ugwu & Eze, 2023). Specifically, the study utilises case studies as its qualitative design (Cohen et al., 2018). Case studies are employed to provide a comprehensive understanding of experiences within their natural contexts (Halkias, Neubert, Thurman & Harkiolakis, 2022). Among various types of case studies, the study uses multiple-case studies (Coombs, 2022), involving data collection and comparison from two different locations.

The study was conducted in the districts of Motheo in South Africa and Maseru in Lesotho. Lesotho is situated within the borders of South Africa. The research involved one university from each mentioned district - designated as South African University (SAU) and Lesotho University (LU) - to compare findings and assess improvements in LTs.

The target population includes participants involved in Social Sciences education, specifically in EE and DSE. The selected sample should represent the target population (Gumpili & Das, 2022). The sample consists of lecturers, student-teachers, librarians, and e-learning and educational technology support specialists. For sampling, the researcher employed a non-probabilistic, purposive technique to identify relevant participants from the university populations (Olasunkanmi & Ademiran, 2023; Stockemer, 2019). Purposive sampling involves selecting participants based on specific characteristics relevant to the research study. This method is commonly employed in qualitative research and when focusing on particular groups (Akpan & Piate, 2023). The sample size included 7 student-teachers in their 4th-year of study, 1 lecturer, 1 librarian, and 1 educational technology support specialist from each institution ensuring that there is at least a balanced understanding of the findings.

Data collection and analyses

The study used interviews as a data collection method, where researchers engage with participants directly. Recently, interviews have increasingly been conducted online, which assist in reducing geographical distances (Brinkmann, 2018). Semi-structured interviews were selected for data collection due to their relevance of eliciting data through interviewees subjective view. The interviewer asked open-ended questions regarding the LTs purpose, and answers were given as much as interviewees could bear. The same questioning style was administered on LTs prevalence, particularly on lectures and in library along with their use rate. Lastly, it covered ownership of devices utilised in support of LTs application. The questions were broadly identical across contacted departments in the study areas to maintain comparative nature of the study. Inconsistencies applied only in some interview techniques across study areas ensuring gathering required data as a response to confronted geographic and financial constraints. According to Madill (2023), interview data is typically recorded using inter alia, notetaking, audio and visual devices, and personal memory. These interviews were conducted via face-to-face interactions, MS Teams, WhatsApp, and email. For physical face-to-face interviews at both institutions, audio and

note-taking were used. Electronic face-to-face interviews conducted via MS Teams at SAU were recorded online and additional notes were taken. WhatsApp interviews were recorded as audio in both institutions, while email interviews at LU were recorded in text format.

Data analysis involves reviewing and organising data to identify similarities, making sense of it, and drawing conclusions (Frey, 2018). For analysing field data, the study employed thematic analysis, which involves identifying themes from the categories established by the researcher (Preiser, Garcia, Hill & Klein, 2021). The analysis used semantic themes, which involve applying meaningful codes derived from the data, and closed coding, which involves extracting codes directly from the data (Kampira, 2021). Codes were assigned for different participants: e-learning and educational technology support specialists were coded as Participant 1, librarians as Participant 2, and lecturers as Participant 3 for each institution. Student-teachers were coded as #1 through #7 per institution. Participants contributed data based on the relevance of their departments to the involved LTs. With a diverse group of participants, the study was able to gain insights on LTs for each theme, guided by complementation and/or supplementation within the data.

Ethical considerations

Applications for ethical clearance were submitted to both universities and were approved. Research ethics are guidelines that researchers must adhere to in order to prevent any potential harm or misconduct during and after the study (Cohen et al., 2018). The study implemented informed consent, ensuring that participation was voluntary and not coerced. Additionally, confidentiality was promised, guaranteeing that participants' information would be used solely for the purpose of the study. To protect participant privacy and encourage honest responses, their names were omitted from the study to avoid any potential reluctance to share information due to concerns about being identified.

Study Findings

Table 1.

The purpose of LTs in social sciences education

		Responses	
	Participants	SAU	LU
Source of information	Part. 1		"...they provide learning resources ..."
	Part. 3		"... navigate and exchange learning material on it"
	#4	"... to provide us with everything we need regarding academics in one place"	
	#5	"... access materials"	
facilitate Learning process	#1		"... it is used for teaching just like a physical classroom"
	#6	"...getting notes and discussing in groups. This assists us to have more information than just the textbook"	
Assessment of learning	#4		"... they were a means to be given quizzes for which the answers were given just afterwards"
	#5	"... take tests and submit assignments online"	

Table 1 continuing

Cooperative learning	#5		“...with technology we are able to interact with other students in discussions”
	#6	“...discuss some aspects of the work in groups, which assist us with understanding ...” “... I benefited a lot because when we did not understand in class, we help each other through online group discussion”	“...Whatsapp allows us to discuss and help one another and has helped me to my progress from one year to another. I suggest that there should be tools to help with practice teaching as well”
COVID-19 zero tolerance	#3	... because we as students were not allowed to come to campus during COVID-19, LTs were used”	
	#4		“... during COVID-19, the technology we used were a means to access all our learning materials”

Responses from the two institutions show that Learning Technologies (LTs) are utilised for a shared purpose. Specifically, they serve as sources of information, facilitate learning processes, assess learning outcomes, promote cooperative learning, and help prevent the spread of COVID-19.

Table 2.

The prevalence of LTs in social sciences education

Categories	Participants	Responses	
		SAU	LU
Lecture LTs	Part. 1&3	“... lecturers make use of eThuto (blackboard) to engage with students online and that the most preferred method is using the Learning Management System (blackboard) to submit learning information for students”	“... Thuto (blackboard-Sakai) ... and Zoom”
Usage of lecture LTs	Part. 3	“... the general use of technology for learning mostly applied during COVID-19 and not now so much”	“LMSs are not so much used when the university moved back to face-to-face lecturing after COVID-19”
	#2		“... Thuto was much used during COVID-19 when everybody had to use it. Now we have moved back to using it just now and again”
	#7	“... I don’t use this [Thuto] much; it is not every day that posting is done by lecturers”	
Library LTs	Part. 2	“African Journal Online, EBSCO Host, Emerald, Taylor & Francis, and Science Direct and Proquest Central”	“African Journal Online, EBSCO Host, Emerald, Taylor & Francis, and Science Direct, and Research4Life and JSTOR”

Table 2 continuing

Usage of LTs	Part. 2 #3	“...a wide variety of online sources are available for students to access information needed for their learning at anytime, anywhere they are”	“...we are given a link to access online material from the library and I use it to get additional information”
Institutional devices & connectivity	Part. 2 Part. 3	“...it has laptop connections and both class projection television and monitors... and that ...most classrooms have PowerPoint projections, respectively.” “... on campus, there is a wide coverage of Wi-Fi.”	“... on campus, Wi-Fi and computers are available throughout the year.: The data indicated that students on both campuses have access to the necessary technological hardware, software, and Wi-Fi to effectively engage with their studies.”
Student-teacher devices	Part. 2 #1 #2 #6	“...students have laptops and almost all students have smartphones, and, on a smartphone, we can link to anything these days.” “...I have a laptop and a smartphone, so I only need Wi-Fi, which I get on campus. “I also buy data for my smartphone to use it at home.”	“...we as students have our smartphones and also many have laptops.” “We have access to anything we want.” .

The HEIs have similarly organised lecture LTs. However, their usage became especially significant during the COVID-19 period. Libraries also have LTs available, which student-teachers utilise to access learning materials. Additionally, the HEIs have provided devices and Wi-Fi to support the use of LTs. On a personal level, student-teachers own devices that allow them to effectively explore LTs across the HEIs.

Discussion and Conclusion

The purpose of LTs in Social Sciences education

The study has found that LTs in SAU and LU are planned to be used as the source of information. In SAU, #4 and #5 confirm the intent of their use of LTs as “... to provide us with everything we need regarding academics in one place and ... access materials.” In LU, participants 1 and 3 pointed out that LTs are sources of information by saying “...they provide learning resources ... and ... navigate and exchange learning material on it.” The findings are constant with literature as it highlights LTs provide information for learning to take place (Ogbaji, 2017).

The study found that, at both SAU and LU, LTs are expected to play a supportive role in the learning processes of social sciences education. In SAU, #6 understood LTs as a means that enhance learning facilitation through expressions as “...getting notes and discussing in groups. This assists us to have more information than just the textbook.” In LU, #1 confirmed the purpose of using LTs by saying “... it is used for teaching just like a physical classroom.” The literature supports the findings by indicating that LTs are valuable resources for enhancing the learning process (Cervino & Vera, 2017). In addition, at SAU and LU, LTs are utilised to assess the performance of student-teachers in their learning activities. Within SAU, #5 indicated that LTs enable them to “... take tests and submit assignments online.” In the case of LU, #4 stated that “... they were a means to be given quizzes for which the answers were given

just afterwards.” The use of LTs for assessing learning is supported by Yambi (2018) who states that a key advantage of LTs is their ability to generally provide immediate feedback to both students and lecturers.

The study revealed that LTs at the SAU and LU are expected to provide student-teachers with opportunities to collaborate and engage in cooperative learning, enhancing their educational experience and interactions. In SAU, #6 said that they as student-teachers have the opportunity to “...discuss some aspects of the work in groups, which assist us with understanding ...” In LU, #5 stated that “...with technology we are able to interact with other students in discussions.” In SAU and LU, while it is implied that individualised learning takes place, participants have indicated that cooperative learning is upheld by LTs. In SAU, #6 asserted that “... I benefited a lot because when we did not understand in class, we help each other through online group discussion.” In LU, #5 identically commented that “...Whatsapp allows us to discuss and help one another and has helped me to my progress from one year to another. I suggest that there should be tools to help with practice teaching as well.” This role is supported by literature, which indicates that, in addition to individualized learning, student-teachers also participate in group learning as an additional pedagogical approach (Rawashdeh et al., 2021).

The study found that at SAU and LU, LTs are anticipated to support both on-campus and off-campus student-teachers in their learning activities. In SAU, participant 1 indicated that LTs “...enable us to get resources on our own anywhere and at any time we want for learning.” In LU, participant 2 said that “... the library website is the learning page for us students, the staff and everybody. There are also part-time students, and with electronic platforms everybody can access information.” The literature aligns with the findings, indicating that learning - whether individualised or group-based - can occur regardless of where student-teachers are located (Fernandez-Batanero et al., 2022).

The study revealed that SAU and LU initially planned to use LTs as a strategy to enforce a zero-tolerance policy for the spread of COVID-19 among student-teachers. In SAU, #3 stated “... because we as students were not allowed to come to campus during COVID-19, LTs were used.” In LU, #4 indicated that “... during COVID-19, the technology we used were a means to access all our learning materials.” The literature, consistent with the findings, indicates that LTs were once relied upon to control the spread of COVID-19 by preventing physical contact among student-teachers (Coman et al. 2020).

The prevalence of LTs in Social Sciences education

At SAU and LU, LTs used for lectures and in certain instances, assessments, include eThuto and Thuto, respectively. In SAU, participants 1 and 3 said “... lecturers make use of eThuto (blackboard) to engage with students online and that the most preferred method is using the Learning Management System (blackboard) to submit learning information for students”. In LU, participants 1 and 3 asserted that LTs involve, inter alia, “... Thuto (blackboard-Sakai) ... and Zoom.” Consistent with the literature, Jolaosho (2023) indicates that within Economics Education, lecturers use online platforms for disseminating information and communicating with students, enhancing the overall educational experience.

The study also found that the usage rates of eThuto at SAU and Thuto at LU have declined since COVID-19. In SAU, participant 3 commented that “... the general use of technology for learning mostly applied during COVID-19 and not now so much.” #7 stated that “... I don’t use this [Thuto] much; it is not every day that posting is done by lecturers.” In LU, participant 3 pointed out that “LMSs are not so much used when the university moved back to face-to-face lecturing after COVID-19.” #2 opined that Thuto use is scarce specifically saying that “... Thuto was much used during COVID-19 when everybody had to use it. Now we have moved back to using it just now and again.” Adeyemi (2020) assert that LTs are not optimally used in lectures because lecturers lack sufficient motivation to integrate these tools into their teaching methods, leading to underutilisation.

Regarding e-library LTs, the study found that both SAU and LU have similar LTs such as African Journal Online, EBSCO Host, Emerald, Taylor & Francis, and Science Direct. These similarities indicate that social sciences education LTs are multidisciplinary. However, there are also differences: LU uniquely has Research4Life and JSTOR, while SAU exclusively uses Proquest Central. The findings are supported by literature from Mbambo-Thata (2021), which highlights LTs like EBSCO Host, Proquest, Dawsonera, and JSTOR. These LTs provide access to e-books, e-journals, themes, dissertations, magazines, and newspapers, among other resources.

At both SAU and LU, e-library services utilising LTs are frequently used by students to search for information, significantly supporting their learning processes and academic research efforts. In SAU, participant 2 revealed that "...a wide variety of online sources are available for students to access information needed for their learning at anytime, anywhere they are." In LU, student-teacher #1, #2, #3 and #4 indicated his use of library LTs by stating that "...I never go to the library or use their available online sources, I normally just Google for information." #2 asserted that "...the library offers JSTOR home platform for online material search, which I find very helpful." #3 stated that "...we are given a link to access online material from the library and I use it to get additional information", whereas #4 commented that "... I use the online library and they have a Remotex App that is useful to get information for my courses." This usage aligns with the literature, as Onuoha and Mbama (2021) report that the adoption of e-library services in social sciences education is high, with usage rates ranging between 80 percent and 100 percent.

The study has established that there are complementary LTs in SAU and LU. In SAU, participant 3 stated that "Whatsapp groups are frequently used by lecturers to give us information ...", which has been confirmed by student-teacher #6. #1 indicated that "...I use Google a lot because I can type in different keywords to get information." In LU, #4, #5, #6 and #7 asserted that "...we use Whatsapp messages with lecturers as well as our fellow students. Some students have formed learning groups where they discuss the learning." Only #3 and #7 have mentioned that "...I also use You Tube videos because there are a lot of such videos that link with what we have to learn... and ... we are sending emails if we need to attach a document to the lecturer or other students." The finding aligns with the literature, as Moghavvemi, Sulaiman, Jaafar and Kasem (2018) highlight the use of complementary social media LTs, such as YouTube, Facebook, Google, Instagram, and WhatsApp, in educational contexts.

The study found that both SAU and LU provide computers for student use and also supply Wi-Fi, ensuring that student-teachers have the necessary technological resources and internet access to support their learning. In SAU, participants 2 and 3 noted that the university is equipped with devices, specifically mentioning that "...it has laptop connections and both class projection television and monitors... and that ...most classrooms have PowerPoint projections, respectively." Participant 2 further added that "... on campus, there is a wide coverage of Wi-Fi." In LU, participant 2 stated that "... on campus, Wi-Fi and computers are available throughout the year.: The data indicated that students on both campuses have access to the necessary technological hardware, software, and Wi-Fi to effectively engage with their studies. Erdogan and Serefli (2021) support this, noting that learning institutions typically own devices that facilitate LTs. In social sciences teaching and learning, devices such as desktops and smart boards are commonly used, especially for visual aids.

The study revealed that at both SAU and LU, student-teachers possess personal devices, such as laptops and smartphones, which allow them to effectively engage with and utilise LTs for their education. In SAU, participant 2 stated that "...students have laptops and almost all students have smartphones, and, on a smartphone, we can link to anything these days." #1 and #6 confirmed the afore-mentioned by stating that "...I have a laptop and a smartphone, so I only need Wi-Fi, which I get on campus. I also buy data for my smartphone to use it at home." In LU the responses were similar, indicating to at least have a smartphone and in many instances, also laptops. Both student-teachers #1 and #2 responded that "...we as students have our smartphones and also many have laptops. We have access to anything we want." Ownership of smartphones and laptops are widespread and effective technological tools for communication and learning (Aheto& Cronje, 2018).

The study was guided by a philosophical stance and conceptual framework provided by TPACK, focusing analytically on LTs in terms of their purpose and prevalence within the selected universities. Through the philosophical assumption of axiology (which pertains to the study's significance), the study identified that the purpose of social sciences education LTs is to provide learning information, facilitate learning, and assess performance equally in both SAU and LU. This answers the question regarding the purpose of LTs in social sciences education.

Regarding ontology, the study identified eThuto at SAU and Thuto at LU as lecture-based learning technologies, although their usage was limited. Other technologies were extensively used for information retrieval in libraries. In addition to institutional LTs, student-teachers also utilized

complementary tools such as social media platforms like YouTube and WhatsApp. Successful integration of LTs requires digital skills, and both SAU and LU provide formal training for student-teachers to acquire these skills. This addresses the application of LTs in social sciences education at both universities. Both SAU and LU have succeeded in using available LTs to supply information for learning, facilitate learning, and access resources for developing student-teachers' content knowledge.

As content knowledge is enhanced, pedagogical knowledge is also promoted and practiced through individualised and cooperative learning. Both content knowledge development and pedagogical knowledge support in social sciences education occur regardless of whether student-teachers are on-campus or off-campus. Despite the significant impact of LTs during the COVID-19 pandemic, their usage has declined as lecturers returned to physical classrooms.

To address limiting factors, recommendations include securing funds, expanding Wi-Fi access, providing data, ensuring reliable electricity, and using updated devices. These recommendations aim to mitigate the impact of LTs in social sciences education in SAU and LU from a comparative perspective.

The authors suggest conducting targeted analytical studies to examine the impact of LTs within specific subject specializations, either individually or comparatively. These studies could use a survey-based research strategy to gain a deeper understanding of the application of LTs in various social sciences education programs. The findings obtained in the research can be explained with tables, figures, graphics, or pictures in accordance with the purpose of the study.

In conclusion, the study explored the prospects and prevalence of LTs in Social Sciences education at (HEIs in South Africa and Lesotho. Focusing on the EE program at SAU and the DSE programme at LU, the research found that LTs are predominantly used by student-teachers as key sources of information to facilitate learning, and to conduct assessments. The study also identified libraries as valuable sources of LTs, while student-teachers engage with complementary LTs based on social media platforms that have emerged since 2013. Additionally, the study noted variations in device ownership, with some devices provided by the institutions and others personally owned by student-teachers. Overall, LTs have significantly improved social sciences teacher education in both SAU and LU over time.

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Middle School Students' Approaches to Optimization: Insights into Mathematical Modeling and Real-World Problem Solving

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Abstract

This study investigates middle school students' perspectives on optimization problems in mathematics, focusing on their problem-solving processes and learning experiences. Optimization involves finding the best solution under specific constraints or maximizing/minimizing an objective function, a concept closely related to mathematical modeling. This process is designed to develop essential skills, such as logical reasoning, prediction, argumentation, and critical thinking, by framing real-world situations as mathematical challenges. Although existing research on students' problem-solving with optimization problems primarily involves high school or university students, recent studies emphasize the necessity of introducing optimization concepts earlier in education. This study administered four optimization problems to 16 middle school students to explore their experiences and opinions. Data were collected through observations, feedback forms, and individual interviews and analyzed using descriptive and content analysis methods. The findings reveal that students' limited prior exposure to optimization problems significantly contributes to their challenges. While students generally understand the optimization problems, their performance varies notably, especially in assumption-making and mathematical calculations. The study underscores the need for systematically integrating optimization problems into the middle school curriculum to enhance students' problem-solving skills and critical thinking. It suggests incorporating mathematical modeling with optimization tasks could improve students' abstraction and problem-solving abilities. Future research could investigate the effects of optimization problems on students' problem-solving skills and mathematical understanding.

Keywords: Mathematical education, mathematical modeling, optimization problems, middle school students.

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Introduction

Across all educational stages—from elementary school to higher education—a central goal of mathematics education is to cultivate students' skills in reasoning, problem-solving, and making connections between mathematical concepts and real-life contexts (MoNE, 2018; NCTM, 2000). These competencies are critical for academic achievement and vital for addressing complex challenges in everyday life and future careers. Mathematical modeling bridges abstract theory and practical application (Lesh & Doerr, 2003), enabling students to translate real-world situations into mathematical representations and devise solutions rooted in mathematical reasoning (Borromeo Ferri, 2018). Through this process, students gain a deeper understanding of the relevance and utility of mathematics beyond traditional problem sets.

Educational frameworks worldwide emphasize the importance of incorporating mathematical modeling into curricula, promoting student engagement in tasks that mirror real-world complexity (MoNE, 2018; CCSSI, 2010). This approach fosters a more applied, experiential form of mathematics learning that develops essential 21st-century skills, including critical thinking, creativity, and problem-solving (English, 2023). Within this framework, optimization problems are particularly valuable, offering practical applications across diverse domains (Taranto et al., 2024). Successfully navigating such problems requires the ability to construct, manipulate, and interpret mathematical models, reinforcing the role of mathematical modeling as a cornerstone of contemporary mathematics education.

Mathematical modeling bridges real-world problems and mathematical concepts, enabling students to enhance their analytical thinking and practical application skills (Borromeo Ferri, 2018; Lesh & Doerr, 2003). It fosters critical competencies such as logical reasoning, abstraction, and problem-solving while also integrating 21st-century skills like creativity and critical thinking (English, 2021; 2023). Through an iterative process involving phases like idealizing, mathematizing, solving, and validating, modeling strengthens students' ability to connect mathematics with real-world contexts (Blum & Leiss, 2007; Kaiser et al., 2013). Within this framework, optimization problems play a significant role by linking mathematical theory to practical applications, requiring students to find the best solutions under specific constraints (Taranto et al., 2024). These problems promote the development of heuristic strategies and approximation methods, even in complex scenarios, and achievements in solving them often depend on constructing and articulating representations, highlighting their educational value (Villegas et al., 2009; Lesh & Doerr, 2003).

The research emphasizes the benefits of optimization problems in motivating students, enhancing modeling competencies, and fostering meta-cognitive and problem-solving skills (Greefrath et al., 2022; Ferrarello et al., 2022). Although often absent in many curricula, these problems encourage reflection, discovery, and the real-world application of mathematical concepts, making them essential in mathematics education (Greefrath et al., 2022; Schuster, 2004). However, existing studies predominantly focus on high school and university contexts, leaving a significant gap in research on middle school students (Colajanni et al., 2023; Raffaele & Gobbi, 2021). This highlights the growing need to introduce optimization concepts earlier in education to build foundational skills in mathematics (Sandefur et al., 2022).

This study addresses a gap in mathematics education by exploring middle school students' perspectives on optimization problems, focusing on their opinions, perceptions, and experiences to understand how they engage with and relate to these concepts. By investigating these dynamics, the study sheds light on students' attitudes toward mathematics and their interactions with optimization-related ideas. Insights into students' perspectives will inform educators and curriculum designers on effectively integrating real-world optimization problems into mathematics instruction, as Greefrath et al. (2022) highlighted. Additionally, the study emphasizes the role of optimization in fostering critical thinking, problem-solving, and modeling skills, aligning with findings by Lehmann (2024) and Ferrarello et al. (2022) that demonstrate how optimization enhances student engagement and learning outcomes. By advocating for the inclusion of optimization in middle school mathematics curricula, the research bridges the gap between abstract mathematical concepts and practical, real-world applications (Taranto et al., 2024). Moreover, the findings may contribute to preparing students for future academic and STEM career challenges by demonstrating how optimization cultivates essential 21st-century skills such as creativity,

logical reasoning, and critical thinking (English, 2021; Sokolowski, 2015). The study seeks to enhance students' appreciation of mathematics and sustain their motivation and long-term interest in the field. It addresses the need for earlier exposure to optimization concepts identified by Sandefur et al. (2022) and Raffaele and Gobbi (2021).

The research questions are as follows.

1. What are middle school students' views on optimization problems in mathematics?
2. What challenges and achievements do middle school students encounter while engaging in optimization problems, and how do they approach the problem-solving process for optimization problems?

Literature Review

Mathematical Modelling

Mathematical modeling bridges abstract theory and practical application, enabling students to translate real-world problems into mathematical terms. Through this process, learners develop analytical thinking skills and enhance their capacity to apply mathematical knowledge in meaningful, context-driven ways. Far from being limited to procedural problem-solving, modeling promotes a more profound understanding by illustrating how mathematical concepts can be leveraged to address tangible, everyday challenges (CCSSI, 2010; MoNE, 2018; NCTM, 2000). In modeling tasks, students engage in logical reasoning, prediction, and critical judgment, fostering their ability to relate mathematics to real-life contexts (Borromeo Ferri, 2017; Lesh & Doerr, 2003; Author, 2023). This strengthens mathematical competencies and supports the acquisition of essential 21st-century skills, including critical thinking, creativity, and problem-solving (English, 2021; 2023).

Recognizing its transformative potential, educational frameworks and scholarly research advocate for systematically integrating mathematical modeling into school curricula and teacher education programs. Borromeo Ferri (2018) emphasizes the importance of modeling to promote experiential and applied learning, a stance echoed by national and international curriculum standards (CCSSI, 2010; MoNE, 2018; NCTM, 2000). These frameworks highlight the need to move beyond theoretical instruction and provide opportunities for students to engage in authentic problem-solving tasks that mirror the complexity of real-world situations. Consequently, the inclusion of modeling not only reinforces mathematical understanding but also aligns with global educational priorities aimed at preparing students for the demands of contemporary life.

Optimization Problems in the Context of Mathematical Modelling

Optimization is an essential mathematical concept with practical applications in various fields, such as engineering (Taranto et al., 2024). Optimization involves finding the best solution or maximizing/minimizing an objective function under certain constraints. Gomez et al. (2006, p. 301) defined optimization as “doing the most with the least.” Another definition of optimization is “the process of finding the most effective or suitable value or condition” (Lockhart & Johnson, 1996). Optimization aims to achieve the “best” design or outcome given a set of constraints. To achieve this goal, mathematical models are necessary. In this context, optimization problems can also be considered mathematical modeling problems. Solving optimization problems involves creating and solving mathematical models, which illustrate the connections between mathematics and real-world situations. This approach emphasizes the practical relevance of mathematical concepts and encourages learners to engage with the subject meaningfully (Taranto et al., 2024). By tackling these problems, students can develop essential problem-solving skills and enhance their ability to construct and interpret mathematical models. Consequently, optimization problems arising from real-life situations are inherently linked to mathematical modeling (Taranto et al., 2024). They can play a valuable role in generating interest in mathematics and supporting the development of critical thinking and modeling competencies.

Therefore, the investigation into the theoretical concepts of optimization addresses critical questions, such as how optimization can foster the development of heuristic strategies and how students employ approximation methods when exact solutions are impractical. In this context, Sokolowski's (2015) study

supports the hypothesis that immersing students in mathematical modeling activities can effectively challenge their preconceptions and enhance their understanding of core mathematical principles. Notably, the research identifies that the phases involving hands-on measurements and the creation of value tables were particularly influential in altering students' perspectives. Consequently, this structured data collection and analysis approach led students to uncover fundamental optimization principles, thereby illustrating the benefits of integrating measurement tasks into mathematics education.

Moreover, the study (Sokolowski, 2015) suggests that the difficulties students encounter with optimization problems are often tied to understanding the underlying mathematical concepts rather than issues with the mathematization process itself. These findings, therefore, reinforce the argument for a unified structure that combines scientific and mathematical modeling. This integration is particularly relevant given that optimization problems are crucial in STEM education, as they focus on developing formal models to tackle challenges across various fields, including economics, engineering, logistics, and transportation (Taranto et al., 2024). By engaging students in constructing and solving mathematical models, optimization problems demonstrate the practical relevance of mathematics in real-world scenarios. Thus, this connection enhances students' problem-solving and modeling skills and fosters a more profound interest in mathematics, making optimization a vital component of the broader STEM curriculum.

Villegas et al. (2009) found that success in solving optimization problems is closely linked to the ability to construct, use, and effectively articulate representations. This insight is particularly relevant to mathematical modeling, where the process involves translating real-life situations into mathematical models, manipulating these models, and interpreting results in the context of the original problem (Lesh & Doerr, 2003). Building on the findings of Villegas et al. (2009), which emphasize the critical role of constructing, utilizing, and articulating representations in solving optimization problems, this study delves into middle school students' perspectives on optimization. By exploring their opinions, perceptions, and experiences with these concepts, the study aims to illuminate the connections between students' attitudes toward optimization and their broader mathematical learning experiences. It also seeks to provide insights into how students interpret and engage with optimization-related ideas, further enhancing our understanding of their relationship with mathematics.

Mathematical modeling typically follows a cyclical process (Blum & Leiss, 2007; Geiger, 2011; Lesh & Lehrer, 2003). The modeling process (figure 1) is characterized by several phases: (a) idealizing, structuring, and simplifying; (b) mathematizing, translating into mathematical language, and formulating; (c) mathematical work, operating, and solving; and (d) interpreting and validating (Kaiser et al., 1996, Blum, 1996). The ability to skillfully navigate these phases is crucial for effective modeling, as it enables students to move fluidly between real-world scenarios and their mathematical abstractions, ensuring that models accurately reflect problems and lead to viable solutions (Lesh & Doerr, 2003). This modeling cycle highlights that while modeling skills are multifaceted and iterative, they are essential for translating mathematical theory into practical problem-solving strategies.

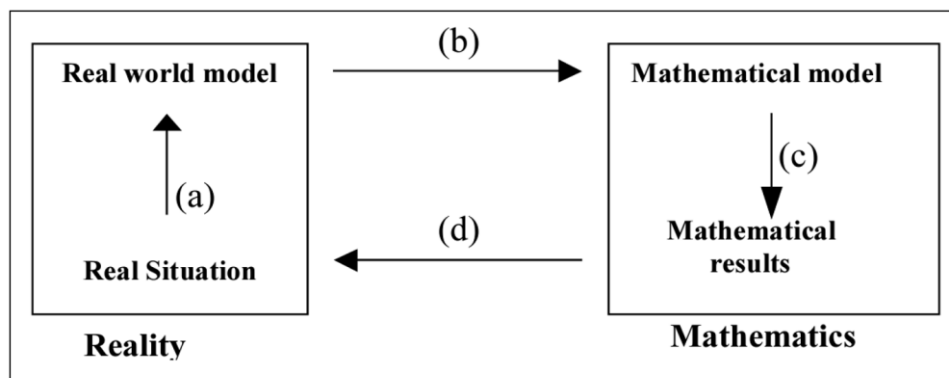


Figure 1. Modeling Cycle (from Kaiser, 1996, p. 68; Blum, 1996, p. 18)

Optimization problems hold substantial educational value and can significantly enhance students' mathematical learning across different educational levels. Taranto et al. (2021) demonstrated that

implementing a modeling pathway involving optimization tasks is manageable for typical higher secondary students and leads to positive outcomes across multiple domains. Their findings revealed increased motivation—as students willingly worked through breaks—and the development of meta-cognitive skills and productive work habits. Notably, the pedagogical goal of helping students better understand the world around them was also achieved. These results support the inclusion of optimization problems in regular mathematics instruction, even if not on a daily basis, as they contribute to attaining broad educational objectives. Similarly, Ferrarello et al. (2022) emphasize the educational benefits of integrating optimization problems into middle school curricula. Their study highlights how hands-on problem-solving encourages students to apply mathematical concepts through modeling and fosters connections between real-world contexts and abstract mathematical strategies. This experiential, “learning by doing” approach promotes discovery, critical thinking, validation, and argumentation—key elements of meaningful mathematical engagement.

Reinforcing these findings, Greefrath et al. (2022) show that optimization problems—though not formally part of many curricula—offer rich opportunities for learning and engagement. Their research demonstrates that these problems enhance mathematical reflection and motivation by embedding mathematical thinking within real-world contexts, leading to intensive and diverse modeling processes. Particularly within discrete mathematics, optimization tasks support the development of process-related competencies and sustain student interest through challenging and relevant content. These studies highlight the importance of introducing optimization problems early in the educational journey. Doing so not only cultivates students' modeling abilities but also fosters a more engaged and motivated approach to mathematics, aligning with 21st-century educational goals.

Building on this, Lehmann (2024) explored how mathematical modeling can further support the development of students' algorithmic thinking. The study revealed that mathematical modeling activates crucial modeling competencies for fostering algorithmic thinking. Specifically, students dedicated considerable time to analyzing information and creating abstract representations of problems, identifying relevant variables, and making assumptions—critical factors in their achievements. This underscores how mathematical modeling enhances abstraction skills and problem-solving abilities and complements the findings of Greefrath et al. (2022) by demonstrating the practical benefits of modeling in educational settings. These findings align with the aim of this study, which investigates middle school students' perspectives on optimization problems. By focusing on middle school students' opinions and experiences, this study seeks to understand how they engage with optimization concepts, including the abstraction and problem-solving skills emphasized by Lehmann. Furthermore, it explores how these perspectives influence their attitudes toward mathematics and interactions with optimization-related ideas, providing a deeper understanding of the role of modeling and optimization in mathematics education.

The existing literature reveals a substantial gap in research concerning optimization-based educational initiatives for middle and higher secondary school students, as Raffaele and Gobbi (2021) identified. Schuster (2004) investigated the integration of combinatorial optimization into mathematics and computer science education for high school students. However, a comprehensive review of the literature indicates that most studies addressing students' problem-solving processes in optimization are restricted to high school (Colajanni et al., 2023; Taranto et al., 2024) or university contexts (Villegas et al., 2009). This highlights a need for research focused on introducing and teaching optimization concepts at middle school levels, especially given the growing significance of optimization in contemporary life (Sandefur et al., 2022). Recent studies advocate for a more detailed examination of how optimization can be effectively taught from an earlier age, emphasizing that foundational skills for understanding and applying optimization should be established well before students enter higher education (Greefrath et al., 2022; Sandefur et al., 2022).

Method

The study employed a qualitative method to comprehensively explore the research questions and facilitate in-depth data analysis (Creswell, 2013). A case study approach was explicitly chosen to understand middle school students' perspectives on optimization problems, often regarded as mathematical modeling challenges. The case study method is particularly effective in examining

complex phenomena (Merriam, 1998; Yin, 2009). By employing this approach, the study aimed to capture the students' experiences and viewpoints on optimization problems in a detailed and contextually grounded manner. Additionally, conducting in-depth case studies of individual students or small groups allowed for a thorough understanding of their interactions with optimization problems and learning trajectories. This method provided researchers with a nuanced and practical understanding of the behaviors of small groups and the dynamics of specific processes, making it a valuable tool for exploring the challenges and perspectives of middle school students as they engage with optimization problems.

Study Group

This study conducted four optimization activities with 16 high-achieving seventh-grade students at a middle school in the Western Black Sea Region in Türkiye. High-achieving students were selected for this study to provide a deeper insight into the potential of optimization problems to challenge and develop advanced mathematical thinking and problem-solving skills. These students, often possessing a stronger foundation in mathematics and critical thinking, are well-positioned to engage with complex tasks requiring abstraction, representation, and iterative reasoning—key optimization components. The study aims to explore their strategies, achievements, and challenges in approaching real-world mathematical modeling problems by focusing on high-achieving students. This focus allows researchers to identify best practices and instructional approaches that can later be adapted to support a broader range of learners in understanding optimization concepts. Furthermore, selecting high-achieving students ensures a rigorous examination of the activities' educational potential, as these students are more likely to engage deeply with the mathematical and conceptual demands of optimization tasks.

These activities were carefully designed using the mathematical modeling process, drawing from the mathematics applications textbook the Ministry of National Education provided. The activities were carefully selected to align with real-world contexts, ensuring they were both engaging and relevant to students' experiences. The design process emphasized problems that required students to utilize critical thinking, reasoning, and representation skills while promoting an understanding of the iterative nature of modeling. Each activity was structured to challenge students' abilities to mathematize real-world scenarios, formulate mathematical models, and validate their solutions effectively. The activities were also chosen to cater to different facets of optimization, ranging from simple parameter adjustments to more complex scenarios, ensuring a comprehensive exploration of optimization concepts. Special attention was given to clarity in problem statements, accessibility of necessary data, and opportunities for collaborative problem-solving.

The implementation occurred during after-school hours during four-day modeling sessions, allowing for an uninterrupted and focused learning environment. Voluntary student participation ensured high engagement and intrinsic motivation. Students worked in groups of three or four, while all groups operated simultaneously in the same environment. This setup facilitated the exchange of ideas and diverse approaches to problem-solving. The problems were presented on paper and through PowerPoint slides on a smartboard to ensure clarity and accessibility. Researchers closely observed the students during the modeling sessions, taking detailed field notes to capture their interactions, problem-solving strategies, and challenges encountered. These observations provided valuable insights into the students' thought processes and engagement with the modeling activities, contributing to the study's data analysis and findings.

During the activities, the students were supervised by two prospective mathematics teachers, who adhered to the principle of minimal assistance. These prospective teachers were in the final semester of their four-year teacher education program, equipping them with theoretical and practical mathematics education expertise. Their involvement as official researchers in a project supported by a national funding source, titled *Optimization from the Perspective of Middle School Students*, further underscored their role in ensuring the study's academic rigor and alignment with research objectives.

To encourage independent modeling activities, no additional instructions were given to the students. Each modeling activity lasted approximately one hour. After the activities, individual interviews were conducted to gather the students' feedback. These interviews lasted 10-15 minutes for each student and took place in a quiet and comfortable environment, with questions designed to be quickly answered by the students. The responses were recorded using audio recording devices, ensuring

accuracy and enabling detailed analysis for the research study. The interviews were conducted by three researchers involved in the project.

The research was conducted by the regulations recommended by the ethics committee and was based on the principle of voluntary participation. Ethics committee permissions were obtained. Informed consent forms were obtained from the parents of the participating students. In the research analysis, the students' names were not used; instead, they were assigned codes such as S1, S2, ..., and S16 to ensure confidentiality.

Data Collection Tools

In this study, four optimization activities were implemented and carefully designed to align with the principles of the mathematical modeling process. These activities were thoughtfully structured to engage students in problem-solving and critical thinking, promoting the application of mathematical concepts in real-world contexts. A detailed activity plan with a pedagogical approach and instructional strategies was employed to facilitate meaningful engagement with the optimization problems was implemented (see Appendix).

Four carefully designed optimization problems were administered to students. These problems were carefully crafted by the researchers within the scope of the research project, incorporating principles of mathematical modeling and the distinctive features of optimization problems. The design process involved ensuring that each problem adhered to the key phases of the mathematical modeling cycle—understanding the problem, idealizing and mathematizing, solving, validating, and interpreting results.

To reflect the essential characteristics of optimization problems, the activities were framed around real-world scenarios that required students to determine the best possible solution under specific constraints. These constraints were integral to the problem design, as they aimed to challenge students to explore heuristic strategies, apply approximation methods, and justify their solutions. The problems were designed to develop students' mathematical reasoning and problem-solving skills and encourage critical thinking and collaborative efforts, which are vital in tackling complex optimization tasks.

The researchers drew on existing literature, such as Borromeo Ferri (2018), and adapted modeling problems to align with the project's educational objectives. Each problem was structured to promote engagement. The design process involved iterative refinement based on pilot testing to ensure the problems were appropriately challenging and accessible for seventh-grade high-achieving students. Two of these problems are illustrated in Figure 2.

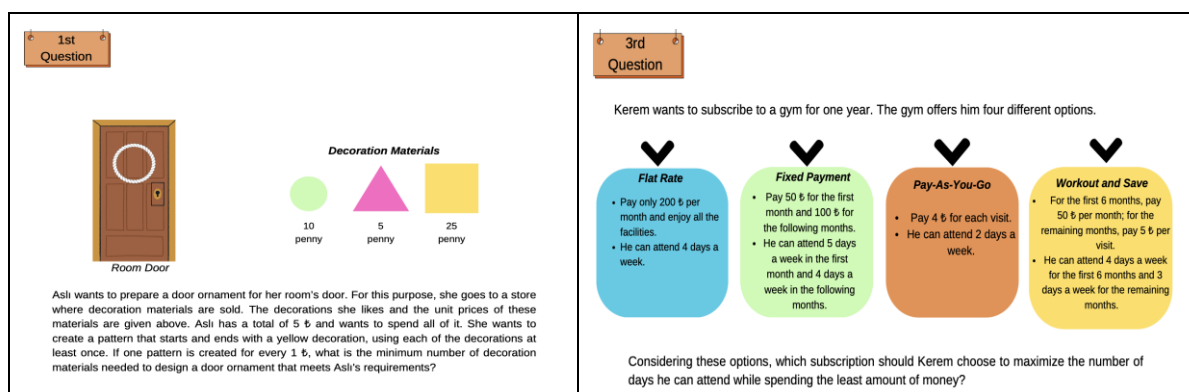


Figure 2. Two Optimization Problems Administered to Students

After completing all optimization activities, individual interviews were conducted with each student. These interviews were conducted in a quiet environment conducive to student comfort, ensuring they felt at ease. During interviews, students responded to questions such as “Can you share your thoughts on the problems you worked on during this study?, Have you encountered similar problems in your previous experiences?, How do these problems differ from the ones you have solved before?, Were there any particular aspects of the problems that you found challenging? Could you explain those parts in more detail?, What aspects of these problems did you enjoy, and what were those you didn't?” Audio recordings were made during the interviews to capture the richness of their responses. The questions

were posed conversationally, allowing students to express their thoughts openly and without pressure. After the interviews, the audio recordings were carefully transcribed into written documents for detailed analysis.

The same set of questions was provided in written form to address the possibility that students might have omitted or forgotten specific details during the interviews. Students were asked to reflect on and respond to these questions in writing, offering additional insight. This approach helped triangulate the data and ensured no important information was overlooked. This comprehensive method marked the conclusion of the data collection process. The study's data consisted of multiple sources, including the students' worksheets, the transcribed information gathered from the interviews, and their written responses to the post-activity questions. By collecting data from diverse formats, the study ensured a robust and multidimensional understanding of the students' experiences and problem-solving processes throughout the optimization activities.

Data Analysis

The qualitative data collected during the study underwent a rigorous descriptive analysis guided by the principles of the mathematical modeling process as outlined by Borromeo Ferri (2018). This analysis involved a detailed examination of the data in relation to the key stages of mathematical modeling, including problem formulation, model development, solution strategies, and interpretation of results, as conceptualized within Borromeo Ferri's framework. The process ensured that the students' responses were evaluated within established modeling practices. This allowed a deeper understanding of their engagement with the mathematical tasks and problem-solving approaches (Table 1).

Table 1.

Framework for Mathematical Modeling Competencies (+ excellent; * doubtful; – misconceptions/incorrect) adopted from Borromeo Ferri (2018, p. 105).

Task 1	Understanding the Problem	Making Assumptions	Mathematizing	Working Mathematically	Validation/Critical Thinking
Student 1	+	*	-	*	*
Student 2	*	*	-	*	*
Student 3	+	+	+	+	+
Student 4	*	+	*	*	+
...					
...					

This framework facilitated the observation of variations in students' modeling competencies over time. It provided valuable insights into individual performance within group settings and offered an alternative assessment method to traditional testing by evaluating students' modeling abilities.

The content analysis method was employed in this study to evaluate students' responses to interview questions systematically. Content analysis involves identifying codes, categories, and themes from qualitative data. Significant patterns and points within the data were initially extracted as codes, which were then organized into broader categories to develop overarching themes. This method aligns with Creswell's (2013) approach to qualitative analysis, allowing for a structured examination of the students' problem-solving strategies, challenges, and perceptions of optimization problems.

Several strategies were implemented to ensure the validity and reliability of the analysis. Validity was ensured through peer debriefing, where other researchers reviewed the coding process to confirm that the themes accurately represented the students' experiences. Reliability was maintained through inter-coder reliability, where two researchers coded the data independently and then compared the results for consistency (Merriam, 1998). The data analysis process followed a straightforward, step-by-step procedure. First, the interview transcripts were thoroughly read to understand the students' responses and identify recurring patterns. Next, initial codes were generated inductively, based on the data, and deductively, using existing mathematical modeling and optimization literature. As the coding

progressed, these codes were refined and grouped into categories, such as “Prior Experience with Similar Problems” and “Discomforts with Problems’ Characteristics.” Finally, overarching themes were developed from these categories to reflect key patterns across the data, such as “Difficulty with Problem Comprehension.” This structured coding and theme development approach ensured the content analysis was systematic and comprehensive.

Findings

This section presents the study's findings under two main headings: Students' Views on Optimization Problems and Students' Achievements and Challenges in the Problem-Solving Process.

Students Views on Optimization Problems

This subsection summarizes students' perspectives on optimization problems, including their prior experience with similar problems, perceived difficulty level, and overall reflections. Table 2 presents students' thoughts on optimization problems, categorized into two main areas: their prior experience with similar issues and the perceived difficulty level.

Table 2.

Prior Experience with Optimization Problems and Difficulty Level

Categories	Common Responses	Students	Frequency
Prior Experience with Similar Problems	I have solved similar problems before.	S-1, S-2, S-7, S-10, S-11	n=5
	I have not solved similar problems before.	S-3, S-4, S-5, S-6, S-8, S-9, S-12, S-13, S-14, S-15, S-16	n=11
Difficulty Level Experienced During Problem-Solving	I struggled while solving the problems.	S-1, S-2, S-4, S-6, S-8, S-9, S-12, S-14, S-15, S-16	n=10
	I did not struggle while solving the problems.	S-3, S-5, S-7, S-10, S-11, S-13	n=6

The findings indicate that most students (n=11) had never encountered optimization problems before, while a smaller group (n=5) had prior experience with such problems. In terms of difficulty, a substantial number of students (n=10) reported struggling while solving the problems, regardless of previous experience. On the other hand, six students (n=6) found the problems manageable and did not struggle during the solving process.

S-15: I haven't solved them before, but I think these problems exist. I struggled while solving the questions, but I enjoyed solving these problems.

S-2: These are good questions that make children think more. They are questions that train you to solve complex problems and make them more accessible. I had solved similar problems before.

S-1: It challenged me a bit. Since there wasn't a clear answer, I kept thinking. But some were easy. In the rabbit question, I visualized everything in my mind. Question 3 seemed to have a single answer, but it was clear that the others had different answers. I solved similar questions in primary school, and I am solving them now as well.

Student comments further illustrate these findings. For example, S-15 acknowledged the existence of optimization problems in daily life and enjoyed solving them despite struggling. That implies that S-15 recognized the prevalence of optimization problems in real-life situations and expressed a positive attitude toward solving them despite encountering difficulties during the problem-solving process. This suggests that the student knows the practical relevance of optimization problems and is engaged in the intellectual challenge they present. The struggle during the problem-solving process further highlights the complexity of optimization tasks and the cognitive effort required, which may provide insight into the areas where the student needs additional support or development.

S-2 indicated that these questions promote critical thinking and contribute to developing problem-solving skills, suggesting that engaging with such problems can enhance cognitive abilities related to

analytical reasoning and strategic thinking. In contrast, S-1 described experiencing difficulty with the problems, primarily due to the open-ended nature of specific questions. This response highlights the cognitive challenges posed by tasks that lack clear, predefined solutions, which may require higher-order thinking skills.

Table 3 provides an analysis of the aspects students liked and disliked about the optimization activities. The results of the aspects students liked are categorized into four main areas: Problem Language/Writing Style, Enjoyment and Engagement with Problems, Thoughts on Skills Developed by the Problem, and Real-life Related Features of Problems. The results of the aspects students disliked are categorized into three main areas: Discomforts with Problem Characteristics, Preferences in Problem Features, and Absence of Dislikes.

Table 3.
Liked and Disliked Aspects of Problems

	Categories	Common Responses	Frequency
Liked Aspects	Positive Aspects of Problem Presentation (Clarity, Visuals, and Creativity)	I liked that the mathematical concepts were understandable. I liked the visuals in the problem. I liked that it was written in an understandable language. The storytelling in the problem was very nice. I liked that the activity was colorful.	n=10
	Enjoyment and Engagement with Problems	The problems were fun. The problem was easy. There was a variety of questions. The problem was fun and logical.	n=11
	Skills Developed by Problems	I liked that it encouraged thinking differently. I liked that it developed our imagination and ability to notice visuals. I found it fun to reach multiple answers by solving problems through trial and error.	n=3
	Real-life Related Features of Problems	I liked that the questions were based on real-life situations. I liked that the problems involved a lot of steps and were complex. I liked that the element of chance was a bit more prominent.	n=5
Disliked Aspects	Discomforts with Problem Characteristics	I did not like that the questions were long. I found it challenging that the problems had multiple answers instead of a single solution. I did not like that the problems required too many steps.	n=8
	Preferences in Problem Features	I would prefer not to use length measurement units. I did not like that there was no shape in the second question.	n=3
	Absence of Dislikes	There was nothing I didn't like. The problems were quite nice. There was nothing I didn't like. Honestly, they were all perfect.	n=6

Students expressed a strong appreciation for several aspects of the optimization activities. Regarding problem language and writing style, they valued clarity and aesthetic appeal, noting that the engaging storytelling, colorful presentation, and understandable language made the problems enjoyable. Positive responses highlighted the pleasure of problem-solving through trial and error and the effective incorporation of visuals and relatable contexts. For instance, S-13 said, "Solving problems through trial and error made reaching multiple answers enjoyable." S-13 mentioned the enjoyment of solving problems through trial and error and the appealing narrative and visuals.

Regarding problem structure, students favored the inclusion of multiple solutions, which they found logical and reflective of real-life scenarios. The complexity and variety of steps in the problems were praised for maintaining engagement and providing a challenging experience. For instance, S-2 and S-4 said S-2: "I enjoyed that the problems were very challenging, did not have a single answer, included

multiple solution paths, and required many operations.” and S-4: “I liked the inclusion of geometric shapes in the problems.” As noted by S-2, who enjoyed the difficulty and multiple solution paths, and S-4, who appreciated the geometric shapes included in the problems, the complexity and variety of steps in the problems were praised for maintaining engagement and providing a challenging experience.

Students also valued the problems for fostering creative thinking and visual awareness, appreciating the chance to explore multiple answers and develop problem-solving skills. Additionally, the format of the questions, which featured real-life contexts and a higher element of chance, was positively received for making the problems more relatable and engaging. Sample student excerpts are as follows. S-14: “I liked that the parts I enjoyed encouraged different ways of thinking. Overall, it was good.” S-1: “One of the aspects I appreciated was that it enhanced our imagination and ability to notice visuals.”

On the other hand, many students expressed dissatisfaction with certain aspects of the optimization activities (see sample responses in Table 3), particularly the length and complexity of the problems. Problems that required numerous steps and offered multiple solutions were especially challenging, leading to difficulties for some students. The length of the questions and the complexity of calculating length measurement units were specific sources of discomfort. Additionally, a few students had discrepancies for particular problem features, such as the use of length measurement units and the absence of particular shapes. Despite these issues, a minority of students reported no dislikes, indicating overall satisfaction with the problems.

Students’ Achievements and Challenges in the Problem-Solving Process

Table 4 analyzes students' problem-solving skills in different optimization tasks. Although all students ($n = 16$) grasped the problem well, their performance varied in later stages. Some students excelled in making assumptions and mathematization, while others faced challenges, particularly in mathematical operations and critical thinking, where difficulties in result validation were common.

Table 4.

Evaluation of Students During the First Optimization Activity (+ Excellent; * Suspect; – Conceptual Errors/Mistakes)

Prb# Std#	Understanding the Problem				Making Assumptions				Mathematization				Working Mathematically				Validation/Critical Thinking			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
S-1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	*	+	+	*
S-2	+	+	+	+	-	-	+	+	+	+	+	+	-	+	+	+	-	*	+	*
S-3	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+	*	+	*
S-4	+	+	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-	+	-
S-5	+	+	+	+	+	-	+	*	+	+	+	+	+	-	+	+	+	-	+	*
S-6	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-7	+	+	+	+	-	+	+	*	+	+	+	+	+	+	+	+	+	+	+	*
S-8	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	*	+	+	+
S-9	+	-	+	+	-	-	*	*	-	-	+	+	-	-	+	+	*	-	*	*
S-10	+	+	+	+	+	-	+	*	+	+	+	+	+	+	+	+	*	-	+	*
S-11	+	+	+	+	+	-	+	*	+	+	+	+	+	+	+	+	*	-	+	*
S-12	+	+	+	+	-	-	+	+	-	+	+	+	-	+	+	+	*	*	+	*
S-13	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	*	+	+	*
S-14	+	+	+	+	+	-	-	*	+	-	+	*	-	-	+	*	*	-	*	*
S-15	+	+	+	+	+	*	+	*	+	+	+	+	-	+	+	+	*	*	+	*
S-16	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	*

As presented in Table 4, all students ($n = 16$) demonstrated a comprehensive understanding of the problem, indicating that they effectively grasped the problem's requirements and context. However, a divergence in performance was observed in subsequent stages of the problem-solving process.

Specifically, 9 out of 16 excelled in making assumptions, while 7 out of 16 struggled, suggesting that nearly half of the students faced challenges in formulating accurate or relevant assumptions. In the

mathematization phase, 12 out of 16 students effectively translated the problem into mathematical terms, whereas four students encountered difficulties.

When applying mathematical methods, nearly half of the students succeeded in working mathematically, with 9 out of 16 facing challenges, highlighting a significant struggle in executing the required mathematical operations. During the validation and critical thinking stage, 9 out of 16 exhibited uncertainty or potential issues in their results, and four students made significant conceptual errors. Only three students displayed excellence in critical thinking and validation. These findings indicate that while students generally understood the problem well, they experienced substantial difficulties in later stages, particularly in making assumptions, executing mathematical operations, and validating their solutions. The data underscores the need for targeted instructional support to enhance students' mathematical reasoning and critical thinking skills.

As presented in Table 4, the analysis of the solution papers from the second optimization activity revealed that while most students understood the problem, a considerable number faced substantial challenges during the assumption-making stage. This difficulty was particularly evident in students like S-4, S-5, and S-14, who either struggled to establish relevant assumptions or did not engage in this step. The assumption-making phase, critical for simplifying and structuring the problem mathematically, presented a barrier to effective problem-solving for these students. Their difficulty in this area may indicate a need for further instruction or guidance in identifying and formulating key assumptions that can facilitate the progression to subsequent stages in the modeling process.

This difficulty appeared to stem from a misconception that the problem had only one solution approach. For instance, when tasked with designing a garden with a perimeter of 316 meters to maximize the area, 50% of the students mistakenly believed that the garden should exclusively be rectangular, overlooking the fact that a square is also a particular type of rectangle. Additionally, some students incorrectly insisted that the garden be hexagonal. These misconceptions highlighted substantial deficiencies in area calculation. Despite a general understanding of the problem, students faced challenges in making assumptions and the mathematical working stages. The most significant difficulties were observed during the critical thinking phase, where students struggled to interpret their results effectively. It was found that students who excelled in the critical thinking stage provided explanations rooted in their initial assumptions.

Upon examining the students' responses to the third optimization problem, it was found that most students achieved their highest achievement during the mathematization stage. Remarkably, students demonstrated the most tremendous achievement in clearly presenting their assumptions for solving this problem, with 6th-grade students showing a higher overall achievement level. In contrast, the review of answer papers for the third optimization activity indicated that while students were successful in the mathematization stage and recognized possible solution methods, they encountered prominent issues related to calculation. Specifically, students struggled with ratios and proportions during the calculation process, further underscoring the need for targeted instruction.

The results of the fourth optimization activity, as presented in Table 4, indicate that students achieved their highest achievement at the problem-understanding stage. An analysis of the students' solution papers revealed that most students relied on a trial-and-error approach to solve the problem. While most students demonstrated a strong understanding of the problem, as evidenced by their "+" ratings, their performance in making assumptions varied. Some students showed proficiency in this area, whereas others had mixed or questionable performance. In the mathematization stage, most students were successful, receiving favorable ratings, and many also performed well in the mathematical working stage, though some encountered issues or gaps. The most significant variability was observed in the validation and critical thinking stage, where some students excelled, but others struggled, indicating deficiencies in these areas. These findings suggest that while students generally excelled in understanding the problem and mathematization, they faced challenges in assumption-making and critical thinking, highlighting areas where further instructional support may be necessary.

A comparative analysis of the results across the optimization activities reveals distinct patterns in students' problem-solving abilities at various stages. In the second optimization activity, students generally comprehended the problem well but struggled significantly with making assumptions. This

challenge was partly due to a misconception that the problem had only one solution approach. Additionally, there were notable deficiencies in area calculations, particularly when students were required to consider different geometric shapes. In contrast, students in the third optimization activity succeeded in the mathematization stage but encountered difficulties in the calculation process, specifically with ratios and proportions. This indicates a gap in their ability to apply mathematical concepts accurately during problem-solving.

In the fourth optimization activity, students achieved the highest achievement at the problem-understanding stage, like the earlier activities. However, the reliance on a trial-and-error approach was prominent. While many students performed well in the mathematization and mathematical working stages, challenges persisted in the assumption-making and validation stages. The critical thinking stage revealed significant variability, with some students excelling while others struggled, indicating deficiencies in interpreting and validating their results.

While students consistently demonstrated an ability to understand the problem across all activities, their performance varied in subsequent stages. The assumption-making stage emerged as a recurring challenge, particularly in the second and fourth activities, whereas the third activity highlighted difficulties in mathematical calculations. The critical thinking stage consistently presented challenges. Table 5 summarizes students' achievement on optimization problems, divided into positive and negative perspectives.

Table 5.
Students' Achievement on Optimization Problems

Categories	Common Responses	Students	Frequency
Positive Perspectives	Code 3. It strengthened my perspective on mathematics.	S-1, S-2, S-3, S-7, S-8, S-9, S-10, S-11, S-13, S-14, S-15, S-16	n=12
	Code 5. I saw that people can come up with different solutions to problems.		
	Code 1. I learned that not all questions have definite answers.		
	Code 4. It helped me understand the difference between the math taught in school and real-world math problems.		
Neutral Perspectives	Code 2. It didn't change my perspective.	S-4, S-5, S-6, S-12	n=4

Most students (n=12) expressed positive views, while a smaller group (n=4) held neutral opinions. Among those with positive perspectives, students reported several benefits from engaging with optimization problems. Many students (Code 3) felt that the problems strengthened their understanding of mathematics. Others (Code 5) appreciated seeing that people can develop different solutions to the same problem, which broadened their problem-solving approach. Some students (Code 1) found it valuable to learn that not all questions have definite answers, which added complexity and interest to their mathematical thinking. Additionally, several students (Code 4) recognized that these problems helped them understand the difference between the math taught in school and real-world mathematical applications. Following are sample excerpts from the students.

S-8: Yes, it positively changed my perspective. Normally, I enjoy solving math problems, but after a while, I get bored. Sometimes, I think about not reading or solving them. However, I liked that there could be more than one answer because I automatically lose interest in math when I can't find the answer to a problem. But here, there is no such thing as not finding an answer because I can give multiple answers.

S-13: Yes, my perspective changed a bit. I learned that a situation could have more than one answer. I realized I could solve this by trying different approaches. It also created a different perspective for me in my daily life.

S-16: I saw that the questions have different solutions, making it fun.

S-7: Yes. These questions are not like other questions; they are easier, and you don't feel like you could get the wrong answer, so you don't feel pressure, making it easier to reach the correct solution.

S-8 shared that the problems positively changed their perspective by allowing for multiple answers, which made math more engaging and reduced the pressure of finding a single correct solution. S-13 mentioned that understanding a situation could have various answers, and applying different methods to reach a solution contributed to a shift in their daily life perspective. S-16 found the variety of solutions fun, and S-7 appreciated that the problems were less intimidating, making it easier to arrive at the correct answer. On the other hand, four students with neutral perspectives (Code 2) indicated that the problems did not change their view of mathematics.

These excerpts indicate that most students gained valuable insights and a more positive outlook on mathematics through their experiences with optimization problems. However, a small subset of students did not experience a shift in their perspective.

The analysis of challenges students experienced with optimization problems, as summarized in Table 6, reveals two primary categories of difficulty: Difficulty with Problem Comprehension and Complexity of Solution Process.

Table 6.
Challenges Students Experienced with Optimization Problems

Categories	Common Responses	Students	Frequency
Difficulty with Problem Comprehension	I struggled to understand the problem situation. Using length measurement units made it difficult for me to understand the question.	S-4, S-11, S-10, S-15	n=4
Complexity of Solution Process	The solution steps were too long. I got confused while solving it. The many solution strategies and operations required made it difficult for me.	S-2, S-3, S-5, S-7, S-12, S-13, S-14, S-16	n=8
No Difficulty Experienced	I didn't struggle at all.	S-1, S-8, S-15	n=3

A notable subset of students encountered difficulties in understanding the problem situation, impeding their ability to engage with optimization problems effectively. Specifically, Student S-4 said, "Understanding the problem situation and many solution strategies made it difficult for me." S-4 reported challenges in grasping the problem scenario, highlighting difficulties with the problem context and the required solution strategies. Similarly, S-16 stated that "Mathematical concepts seemed confusing. The visuals in the first question were confusing." S-16 found the mathematical concepts and accompanying visuals confusing, further exacerbating the problem.

Some students mentioned that they experienced difficulties because the mathematical concepts were not understandable. These issues underscore the critical role that clarity and effective presentation of mathematical concepts play in facilitating students' comprehension and problem-solving abilities in optimization tasks. A significant proportion of students (n=8) expressed the challenges related to the complexity of the solution processes in optimization problems. For instance, S-2 said, "Question 3 was the part I struggled with because the operations were lengthy. Performing all four premises one by one was challenging for me." Student S-2 reported that the problem-solving steps were excessively lengthy, leading to confusion and difficulty managing multiple solution strategies.

This complexity, characterized by numerous steps and operations, emerged as a significant barrier to effectively solving the problems. Student S-13 noted, "Question 3 was the part I struggled with because the operations were lengthy. Performing all four premises one by one was challenging for me." Thus, S-13 stated that Question 3 was particularly problematic due to the extensive operations required, making performing all four premises sequentially challenging. These findings highlight that the intricacy of the solution processes significantly impedes students' ability to navigate and solve optimization problems successfully.

A smaller group of students ($n=3$) reported no difficulties with the optimization problems, suggesting that these individuals either found the problems straightforward or possessed strategies that mitigated the common challenges faced by others. For instance, students S-1, “I didn’t struggle with any part,” and S-8, “I didn’t struggle at all,” indicated that they did not experience any struggle with the problem-solving tasks. These findings highlight that difficulties with optimization problems are primarily associated with the structure and complexity of the problems themselves. Specifically, issues related to problem comprehension and the extensive nature of solution processes are significant challenges for students.

Discussion, Conclusion, and Suggestions

This study aimed to explore middle school students' perspectives on optimization problems in mathematics, focusing on their opinions, perceptions, and the impact on their learning experiences. This study aimed to explore middle school students' perspectives on optimization problems in mathematics, focusing on their opinions, perceptions, and the impact on their learning experiences. The study sought to investigate how students engage with optimization tasks and the strategies they employ. By examining their attitudes and thoughts about optimization, the research also aimed to uncover the underlying factors influencing students' willingness to tackle complex mathematical challenges. Furthermore, the study intended to identify students' challenges and achievements during their problem-solving processes, shedding light on difficulties in applying mathematical concepts to real-world scenarios. An essential research component was understanding how students conceptualize optimization, particularly in making assumptions, mathematization, and validating their solutions. By exploring these aspects, the study hoped to provide insights into the role of optimization in middle school mathematics education, including the potential for enhancing students' problem-solving skills, critical thinking, and overall mathematical understanding. Through these findings, the research offered recommendations for improving the teaching and learning of optimization concepts, ensuring that students not only grasp mathematical principles but also develop a deeper appreciation for their relevance and application in everyday life.

The findings from this study reveal that middle school students' limited prior exposure to optimization problems significantly contributed to the challenges they faced in solving them. This observation is consistent with the literature, which underscores the importance of early exposure and targeted instructional support to help students navigate the complexities of optimization concepts. Ferrarello et al. (2022) highlighted that integrating optimization problems into the middle school curriculum can provide substantial educational value by fostering a hands-on, experiential learning approach. This "learning by doing" method deepens students' understanding of mathematical concepts and enhances their ability to apply them through critical thinking, verification, and argumentation.

Moreover, the recurring challenges observed in the assumption-making and critical-thinking stages suggest a need for enhanced instructional strategies. Lehmann (2024) supports this notion by demonstrating that mathematical modeling effectively activates critical competencies for fostering algorithmic thinking, which is closely related to optimization skills. Students who engage in mathematical modeling spend considerable time analyzing information, creating abstract representations, and making assumptions, which are crucial for achievement in optimization problems. Therefore, integrating mathematical modeling with optimization can further enhance students' abstraction skills and problem-solving abilities.

The study also found that while students generally demonstrated an ability to understand optimization problems, their performance varied significantly in later stages, particularly in assumption-making and mathematical calculations. These findings align with Greefrath et al. (2022), who emphasized that optimization problems offer significant educational benefits despite not being traditionally included in the curriculum. By engaging students in real-world applications and diverse modeling processes, optimization problems stimulate mathematical reflection and motivation. This reinforces the idea that incorporating optimization problems into the curriculum can help students develop essential process-related competencies and maintain their interest in mathematics.

Given that the students in this study are high achieving, the findings provide valuable insights into their problem-solving abilities and highlight areas where even advanced students face challenges. While all

participants demonstrated a solid understanding of the problem requirements and context, the study revealed significant performance variability as students progressed through the stages of problem-solving. Despite their strong foundational grasp, approximately 25% of the students struggled during the mathematization phase. This indicates that even high-achieving students can encounter difficulties transitioning from conceptual understanding to formal mathematical representation. This suggests that although students can comprehend the problem context, they may face challenges in mathematical structuring, a critical skill for optimization tasks.

Furthermore, while some students exhibited proficiency in making assumptions and translating the problems into mathematical terms, others struggled with mathematical operations and critical thinking. The difficulties observed in subsequent stages, such as mathematical operations and validation, point to potential gaps in deeper mathematical understanding or insufficient strategies for checking the accuracy of their solutions. These challenges may be compounded by the complex, open-ended nature of optimization problems, which require technical proficiency and reflective and critical thinking. These findings are consistent with Sokolowski's (2015) observations that students' difficulties with optimization problems often stem from challenges with underlying mathematical concepts rather than the mathematization process itself. This aligns with the notion that even high-achieving students may struggle with certain fundamental aspects of mathematical modeling, particularly when faced with the need for validation and critical reflection.

The integration of scientific and mathematical modeling is particularly crucial, given the role of optimization problems in STEM education. Taranto et al. (2024) highlight the importance of optimization in developing formal models for real-world challenges across various fields such as economics, engineering, logistics, and transportation. By engaging students in constructing and solving mathematical models, optimization problems illustrate the practical relevance of mathematics and enhance students' problem-solving and modeling skills. This engagement can foster a more profound interest in mathematics, reinforcing its significance within the broader STEM curriculum.

Based on the findings and discussion from this study, future research could investigate strategies for systematically integrating optimization problems into the middle school curriculum, which could provide insights into how different levels of exposure to these concepts impact students' problem-solving skills and overall mathematical understanding. Additionally, research should focus on integrating mathematical modeling with optimization problems to enhance students' abstraction and problem-solving skills, evaluating how well modeling activities complement optimization tasks and influence students' abilities to make assumptions, construct models, and validate results. Finally, exploring how optimization problems can be more effectively linked to real-world applications within the STEM curriculum could reveal how contextualizing these problems in fields such as engineering affects student engagement and understanding.

In conclusion, this study highlights the importance of incorporating optimization problems into middle school education. The findings underscore the need for targeted interventions and instructional strategies to address the challenges students face with optimization problems, ultimately contributing to more effective and engaging mathematics modeling. While studies like those by Schuster (2004) and Colajanni et al. (2023) have explored optimization in high school and university contexts, research is needed targeting middle school students. Raffaele and Gobbi (2021) and Sandefur et al. (2022) argue that introducing optimization concepts at an earlier age is crucial, given the growing significance of optimization in contemporary life. Establishing foundational skills in optimization before students reach higher education can better prepare them for the complex challenges they will face in their academic and professional futures.

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we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Appendix

Optimization Activity Plan (adapted from Borromeo Ferri (2018))

Time	Section	Activity	Materials / Social Interaction
5 min	Introduction	The researchers introduce the optimization concept to the students before the activity begins. Students are briefed about optimization problems through a researcher-led presentation.	Researchers' presentation
5-10 min	Group Formation & Activity Sheet Distribution	The researchers divide the class into groups of 3-4 students, depending on the number of participants. The activity sheet, illustrated below, is distributed to each group. The researchers provide brief information about the activity, explaining that it includes modeling questions and requires the students to approach drawing and calculations differently. Equal participation from every group member is emphasized, and any questions about the activity are addressed.	Activity sheet, PowerPoint presentation
20-25 min	Group work	Students are given a total of 40 minutes to complete the activity. During this phase: The researchers act as a guide but do not provide direct answers to questions aimed at finding the correct solution. Students collaborate within their groups to solve the problem using problem-solving skills and discuss their ideas with group members. Cooperative learning is encouraged, and enough time is allocated to allow students to explore solutions. The researchers monitor the groups, offering motivational feedback, hints, and comments as needed. Strategic questions are asked to encourage students to question their solutions. At the end of the activity, students prepare for the presentation phase, engaging in discussions within their groups to compare solutions and organize their findings. Cooperative learning is emphasized in this preparation stage. Finally, groups present their solutions to the class, facilitating knowledge exchange and comparing approaches.	Activity sheet, group collaboration
20 min	Presentations	Groups are selected to present their solutions, not solely based on having the correct answer but also on innovative or effective problem-solving strategies. During presentations: Other groups can add comments or suggestions to enhance the discussion. The focus is on generating diverse ideas rather than determining right or wrong answers.	Students' presentations
10 min	Validation/reflection	Students reflect on their solution steps on the activity sheet, even if they are not fully completed. The focus is on the problem-solving process rather than correctness. The researchers facilitate a whole group discussion for students to share their thoughts and reflections.	Whole group discussion
5 min	Feedback	After the presentations, the researchers collect students' thoughts about the activity. Feedback forms allow Students to share their discoveries, likes, or challenges during the activity.	Feedback forms

Examination of Problems in Middle School Mathematics Textbooks in Relation to the PISA Mathematical Literacy Framework

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Abstract

This research examines the extent to which mathematics problems in middle school textbooks for grades 5 through 8 align with the PISA mathematical literacy framework. The analysis emphasizes key dimensions, including content, context, cognitive processes, proficiency levels, and problem types. Utilizing document and descriptive analyses, the research evaluates textbooks published by Türkiye's Ministry of National Education for the 2023–2024 academic year. Results reveal significant imbalances in the distribution of content areas, with “change and relationships” dominating, while “quantity” is underrepresented. Contextual analysis shows a predominance of “personal” contexts, with limited occupational, social, and scientific scenarios, which restrict students' engagement with real-world applications. Regarding mathematical processes, the emphasis is on procedural tasks, while higher-order cognitive skills are insufficiently represented. Furthermore, the majority of problems correspond to PISA proficiency levels 2 and 3, with minimal representation of levels 5 and 6, highlighting a scarcity of tasks designed to foster advanced mathematical competencies. These findings underscore the necessity for a more equitable integration of content areas, a broader spectrum of real-life contexts, and tasks targeting higher proficiency levels. Recommendations propose a redesign of textbooks to incorporate a wider range of cognitive demands and contextual scenarios, with the aim of enhancing students' mathematical literacy and preparedness for international assessments such as PISA.

Keywords: PISA, mathematical literacy, middle school textbook, problem types.

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Introduction

Mathematical literacy (ML) is widely acknowledged as a critical competency in the contemporary era of information and technology, occupying a central role in modern education systems. As Altun (2020) notes, ML serves not only to integrate mathematical knowledge into everyday life but also to enhance cognitive abilities. It involves applying mathematical concepts to real-world situations, thereby fostering critical thinking and problem-solving skills (Höfer & Beckmann, 2009). The importance of ML in educational discourse is closely tied to the Programme for International Student Assessment (PISA), which evaluates and compares the effectiveness of global education systems (Altun et al., 2022; Kabael, 2019). Beyond theoretical constructs, ML empowers individuals to formulate, apply, and interpret mathematics across diverse contexts (Ministry of National Education [MoNE], 2019; Organisation for Economic Co-operation and Development [OECD], 2013). This broad conceptualization underscores ML's critical role in tackling complex societal challenges and emphasizes the need for educational policies and curricula that prioritize its development. Consequently, the primary goal of mathematics education is to equip students with these essential competencies by creating learning environments that nurture their growth as mathematically literate individuals (MoNE, 2023; OECD, 2019).

In numerous countries, ML is developed through structured educational resources, with textbooks playing a foundational role. Textbooks significantly influence the mathematical competencies students acquire, guiding them toward achieving learning objectives aligned with curricular standards (Alajmi, 2012; Fan et al., 2021; Herbel-Eisenmann, 2007; Valverde et al., 2002). Research highlights their substantial impact on teaching practices and student outcomes (Pepin & Haggarty, 2001; Sevimli, Çelik & Kul, 2022). Notably, aligning textbook content with international benchmarks like PISA enhances the quality of mathematics education, as seen in nations where textbooks effectively incorporate PISA's problem contexts and cognitive demands (Hopkins et al., 2008; Incikabi, Sadak & İncikabi, 2023; Son, 2012; Törnroos, 2005). Recent studies stress the importance of assessing textbooks against the ML framework to ensure students encounter problems and cognitive challenges akin to those in international assessments (Korkmaz, Çelik Demirci & Kul, 2024; Tarim & Tarku, 2022; Wu et al., 2020). Comparative analyses show that textbooks in high-performing education systems feature complex, contextually rich, and cognitively demanding tasks (Bozkurt & Yılmaz, 2020; Çelik Demirci & Kul, 2021). In contrast, textbooks in countries like Türkiye often present a limited range of proficiency levels and problem contexts, potentially contributing to lower PISA performance (OECD, 2023a; MoNE, 2023).

Despite the recognized importance of textbooks in fostering ML, comprehensive evaluations of Turkish mathematics textbooks for grades 5–8 against the PISA framework are scarce. In the 2022 PISA, Türkiye scored 453 in mathematics, ranking 39th out of 81 countries and 32nd out of 37 OECD nations above the global average of 438 but below the OECD average of 472. While 61.3% of students achieved the minimum proficiency level, only 5.4% reached the top level (MoNE, 2023). These results signal an urgent need to better align educational materials with globally recognized ML standards and to implement strategies to boost students' mathematical competencies. Thus, this study aims to analyze and classify problems in mathematics textbooks for grades 5 through 8 using the PISA ML framework, examining their distribution across content areas, contexts, processes, proficiency levels, and structures to assess how well they support ML development.

Theoretical Framework

PISA Mathematical Literacy

The 2018 PISA assessment highlights four key components; content, context, process, and proficiency as essential for evaluating ML. The PISA framework identifies four main mathematical content categories: change and relationships, space and shape, quantity, and uncertainty and data. These categories reflect broad areas of mathematical thinking and align closely with international curricular standards (OECD, 2023a). Consistent across recent PISA cycles, such as 2018 and 2022, these categories provide robust indicators for evaluating the scope and depth of textbook content. The category of change and relationships emphasizes modeling and understanding mathematical changes through the use of equations, functions, and algebraic expressions. Tools such as equations, inequalities, and graphical representations are utilized to describe, interpret, and model dynamic relationships, while data

representation and numerical values are significant for illustrating these connections. The space and shape category encompasses real-world phenomena such as perspective drawing, navigation, and geometric representation. Within this framework, PISA underscores the importance of creating representations, interpreting three-dimensional objects from various perspectives, and understanding maps as vital to fostering ML. The quantity category focuses on quantifying objects and scenarios in the environment, including measurement, dimensions, numbers, units, and numerical trends. Quantitative reasoning within this domain involves interpreting numbers in various forms, predicting outcomes, and evaluating results. Finally, the uncertainty and data category addresses uncertainties encountered in everyday life as well as in scientific and technological contexts. This area incorporates probability, statistical theory, and data identification techniques, while emphasizing skills such as interpreting and presenting data to manage uncertainties effectively. Each content category plays an integral role in understanding and applying mathematical concepts. The problems included in the PISA assessments were carefully designed to ensure a balanced representation across these four categories, with each allocated 25%. This equitable distribution is essential for promoting students' mathematical thinking skills and fostering the development of constructive and reflective thinkers (OECD, 2023b). By encompassing a range of mathematical areas, these categories enable the acquisition of comprehensive knowledge and skills. The contexts in which mathematical problems are presented also play a critical role in determining appropriate problem-solving strategies and representations. In the PISA assessment, these contexts are classified into four groups: personal, occupational, social, and scientific. The personal context includes scenarios related to individual, familial, or social activities such as personal planning, transportation, health, food preparation, shopping, recreation, sports, and travel. Occupational contexts focus on scenarios relevant to work environments across various sectors, emphasizing situations relatable to 15-year-olds. The social context addresses issues within the individual's community, including voting systems, public transportation, government policies, demography, and economics. The scientific context involves problems that apply mathematics to real-world scientific and technological scenarios, such as meteorology, climate science, the medical field, space science, and genetics. The balanced distribution of these context categories, with each allocated 25% in the PISA assessments, prevents dominance by any single context. This ensures that students engage with diverse problem scenarios, preparing them to address real-world challenges effectively while nurturing mathematical thinking in a variety of situations.

In the PISA 2018, the problems were structured into three categories of mathematical processes, each with specific weightings that illustrate the connection between real-world problems and mathematical reasoning. The first process, formulating situations mathematically, accounts for 25% of the assessment. This process involves translating real-world problems into mathematical terms by creating models and expressions that render everyday challenges solvable. The second process, using mathematical concepts, facts, procedures, and reasoning, constitutes the largest portion of the assessment, with an allocation of 50%. During this stage, students apply their mathematical knowledge and skills to analyze situations, draw conclusions, and solve problems using a comprehensive set of tools and techniques. The third process, interpreting, applying, and evaluating mathematical results, is also allocated 25% and requires students to assess the relevance and validity of solutions within the context of the original problem. Together, these processes represent a balanced approach to mathematical engagement, bridging theoretical understanding with practical application. In addition to the processes, the PISA framework categorizes problems into six distinct levels of mathematical proficiency. These levels indicate the depth and breadth of students' mathematical knowledge and their ability to solve increasingly complex problems. The hierarchical structure of proficiency levels provides valuable insights into the progression of mathematical competence, reflecting how students' skills develop over time. The primary objective of this study is to analyze the distribution of problems in middle school mathematics textbooks with respect to content, context, process, proficiency level, and problem structure. Understanding this distribution is crucial for evaluating how effectively textbook problems contribute to the development of students' ML.

Role and Importance of Textbooks

Fan, Zhu and Miao (2013) highlight that textbooks in contemporary education systems serve as essential guides integrating both general and specific teaching objectives, enabling consistent learning outcomes by providing a unified framework for course delivery. Textbooks are crucial in the teaching and learning

process as they reflect the curriculum's content, a notion supported by Haggarty and Pepin (2002) and Stein, Remillard and Smith (2007). Brousseau (1986) emphasizes that textbooks are vital resources that significantly influence both students' self-regulation of learning and teachers' design of course content. According to Erbaş, Alacacı and Bulut (2012), an effective textbook should be crafted with a reader-centric approach to facilitate meaningful engagement with the content. Işık (2008) notes that, similar to their global counterparts, teachers in Türkiye heavily rely on textbooks in their teaching processes. The standards for these textbooks, set by the Board of Education and Guidance, direct teachers on the scope and depth of the subjects to be taught in the classroom. Huang et al. (2022) argue that a quality textbook is beneficial to students and holds a significant place in education, thus underscoring the need for careful analysis and evaluation of textbooks to enhance their effectiveness. Mathematical competencies, aligned with frameworks like PISA, can be developed through well-designed textbook tasks (Yılmaz, Ay & Aydın, 2021). Valverde et al. (2002) describe textbooks as the "de-facto national curriculum," shaping teaching practices and bridging curriculum with classroom implementation. Real-life contexts in textbook problems, as emphasized by Zhu and Fan (2006), enhance learning by engaging students in practical applications of mathematics. However, many textbooks prioritize basic cognitive tasks, offering limited opportunities to interpret and evaluate mathematical solutions in real-world contexts (İncikabi, Sadak and İncikabi, 2023). OECD (2019) stress the need for tasks that cover the full cycle of mathematical literacy—formulating, employing, and interpreting—to prepare students for complex problem-solving. The alignment of textbooks with frameworks like PISA is critical for equipping students with relevant skills.

Research investigating the alignment of mathematics textbooks with the PISA ML framework is relatively scarce, particularly in the context of Turkish educational materials. Existing studies have highlighted significant deficiencies in the depth and complexity of problems presented in these textbooks, especially at higher PISA proficiency levels. For example, İskenderoğlu and Baki (2011) examined an 8th-grade mathematics textbook and found that while it included problems corresponding to PISA proficiency levels 1 through 4, it lacked tasks at levels 5 and 6, which represent advanced problem-solving and reasoning skills. Similarly, Yıldırım (2019) analyzed textbooks from grades 5 through 8, focusing exclusively on the 'change and relationships' content category within the algebra domain. This study revealed a complete absence of tasks at proficiency levels 4, 5, and 6, indicating a notable gap in challenging algebraic content. More recently, Tarim and Tarku (2022) evaluated the grade 8 textbook's alignment with the PISA ML framework across multiple dimensions: content, context, and process. Their findings showed that the 'quantity' category contained the highest number of problems, while 'uncertainty and data' had the fewest. In terms of context, 'scientific' scenarios predominated, with 'social' contexts being the least represented. The process of 'using mathematical concepts and procedures' was most frequently employed, whereas 'formulating situations mathematically' was the least emphasized. Additionally, their analysis identified a significant shortfall in higher proficiency level problems, with no tasks at levels 5 and 6, limited representation at level 4, and some inclusion of open-ended problems. Collectively, these studies underscore a critical limitation in Turkish middle school mathematics textbooks: a lack of complex, higher-level tasks that align with the PISA framework's emphasis on applying mathematical knowledge in real-world contexts.

Despite these insights, prior research has been narrow in scope, often focusing on specific grade levels or content areas rather than providing a holistic view of textbook alignment across all middle school grades (5–8). For instance, İskenderoğlu and Baki (2011) and Tarim and Tarku (2022) concentrated solely on grade 8, while Yıldırım (2019), although broader in grade coverage, limited its analysis to a single content category. This fragmented approach has left a gap in understanding how well Turkish mathematics textbooks, as a whole, prepare students for the demands of the PISA assessment and, more broadly, for mathematical literacy in practical settings. To address this, the current study undertakes a comprehensive analysis of problems from mathematics textbooks across grades 5 through 8, classifying them according to the PISA ML framework's key dimensions: content, context, process, proficiency level, and problem structure. This systematic evaluation aims to provide a detailed picture of the textbooks' strengths and weaknesses, offering insights into their alignment with international standards. By doing so, it seeks to inform curriculum developers about necessary enhancements to better equip students with the advanced problem-solving skills required for PISA and real-life applications, ultimately contributing to the improvement of students' ML.

Method

This study adopted a qualitative document analysis approach to examine the mathematics problems presented in middle school textbooks through the lens of the PISA ML framework. Document analysis is widely used in educational research to investigate written materials and official documents, including curricula and textbooks, as it allows researchers to systematically identify, interpret, and evaluate patterns within the text (Patton, 2014; Yıldırım & Şimşek, 2008).

Selection of Textbooks and Data Collection

This study focused on official mathematics textbooks for grades 5, 6, 7, and 8, published by the Ministry of National Education (MoNE) for the 2023–2024 academic year, with the aim of determining the alignment of textbook problems with PISA’s ML framework. These specific grade levels were selected to capture the educational trajectory leading to age 15, which is the target age group for PISA assessments. The mathematics textbooks for middle school are publicly accessible through the MoNE’s official website. Following a Board of Education decision, these textbooks have been officially approved for use over a five-year period from their publication date. They are widely recommended for teaching in Turkish public schools, ensuring broad distribution and usage among students. The study’s analytical foundation was the complete set of mathematical problems extracted from the chosen textbooks, which are comprehensively detailed in the accompanying Table 1. Each textbook is organized into units and includes sections such as “Are We Ready?”, “Let’s Remember”, “Let’s Learn Together”, “Let’s Research and Think”, “Your Turn”, and “Unit Evaluation.” These sections encompass various problem formats (e.g., gap-filling, matching, multiple-choice, true-false, example solutions, and open-ended problems) designed to address curricular goals. The textbooks were purposefully selected based on three key criteria: (a) official curriculum representation, ensuring nationwide instructional content consistency; (b) relevance to the PISA age group, covering learning progressions for students approaching age 15; and (c) potential for comparative analysis to identify alignment strengths and weaknesses with international mathematical education standards. Brief contextual information about the textbooks is provided in Table 1, including authorship and total number of problems.

Table 1.

Mathematics Textbooks Used in the Research

Class	Textbooks	Authors	Number of Problems
5. grade	Mathematics Textbooks 5 (2023)	Betül Korkmaz, Didem Yiğit Meşe, Hayriye Tuğçe Arslan	346
6. grade	Mathematics Textbooks 6 (2021)	Neziha Çağlayan, Aybike Dağıstan, Betül Korkmaz	804
7. grade	Mathematics Textbooks 7 (2023)	Avni Külköylüoğlu, Mehmet Güneş, Mustafa Selçuk, Yunus Tuğrul	506
8. grade	Mathematics Textbooks 8 (2021)	Hadi Böge, Ramazan Akıllı	455

Data Analysis

A systematic content analysis was performed according to the PISA ML framework to ensure a structured examination of textbook problems. Content analysis, a well-established qualitative research method, involves systematically categorizing textual units based on predefined codes and themes, thereby enabling the identification of patterns and underlying meanings. Prior to initiating the analysis, each textbook included in the sample was thoroughly reviewed. This preparatory phase allowed the two researchers—who each possess specialized expertise in analyzing PISA mathematics items—to gain a comprehensive understanding of the textbooks’ content and organization. The PISA ML framework functioned as the principal data collection instrument and was operationalized in this study as a two-dimensional matrix encompassing content categories, mathematical processes, contexts of ML, and PISA proficiency levels. These proficiency levels are defined as follows: *Level 1*: Students handle familiar problems with all information readily available. They follow instructions and perform basic, routine procedures. *Level 2*: Students interpret straightforward contexts, extract relevant information from one source, and apply basic algorithms, formulas, or rules. They provide simple, direct interpretations of results. *Level 3*: Students follow established procedures, make simple models, and apply basic strategies. They interpret information from multiple sources and demonstrate foundational reasoning skills. *Level 4*: Students handle explicit models in concrete yet complex situations, integrate

multiple representations, and connect these to real-life contexts. They produce coherent explanations and reason insightfully. *Level 5*: Students model complex situations, identify constraints, and evaluate solution strategies. They think strategically, reflect on their approaches, and articulate clear interpretations. *Level 6*: Students apply advanced mathematical knowledge to complex, often unfamiliar problems. They integrate various representations, develop new strategies, and communicate thorough justifications. The content dimension encompasses four domains: change and relationships, space and shape, quantity, and uncertainty and data. The mathematical processes are categorized into three groups—formulating situations mathematically, using mathematical concepts and processes, and interpreting/applying/evaluating mathematical outcomes—while the contexts of ML are classified as personal, professional, social, and scientific. In addition, problem structure types (e.g., gap-filling, matching, example solution, multiple choice, true/false, open-ended) were also examined to capture the breadth of problem formats.

Coding Procedures

To ensure systematic and consistent coding, two researchers with demonstrated expertise in mathematics education and educational measurement collaboratively analyzed 10% of the identified problems from the complete set of textbooks. This approach guaranteed that every textbook and each problem within it was examined by both coders. The coding process was initially guided by the criteria established through the PISA ML framework and a predefined coding scheme. Following the first round of independent coding, the percentage agreement between the coders was calculated by dividing the number of instances where all coders concurred by the total number of coding instances. This calculation resulted in an initial agreement rate of approximately 89% for content, context, and process classifications, and 91% for PISA proficiency levels and problem types. These percentages reflect the ratio of matched codes to the total coding decisions. For instances of initial disagreement, a standardized evaluation table was prepared. This table documented each problematic coding instance along with the differing perspectives of the coders. Subsequently, the coders engaged in a structured discussion, revisiting and deliberating on the disputed items until a consensus exceeding 95% was achieved. This iterative negotiation process served not only to resolve discrepancies but also to refine the coding scheme, enhancing its clarity and applicability.

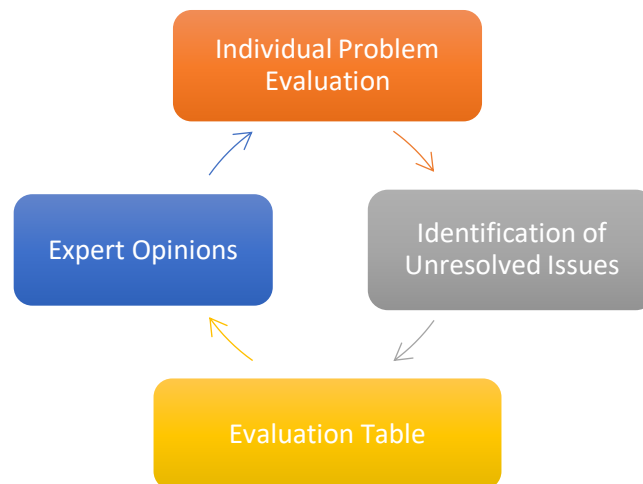


Figure 1. Classification Process Of Problems In Mathematics Textbooks

Sample codes

The content areas covered within the PISA mathematical literacy framework, which serves as the primary data collection tool for the study, are coded as follows: change and relationships as C1, space and shapes as C2, quantity as C3, and uncertainty and data as C4. Situations categorized under mathematical processes are coded as mathematical formulation as P1, using mathematical concepts, facts, procedures, and reasoning as P2, and interpreting, applying, and evaluating mathematical results as P3. Situations unrelated to any classification under ML contexts are coded as NC (No Context), while personal context is coded as C1, occupational context as C2, societal context as C3, and scientific context as C4. Competency levels under the PISA framework are coded sequentially from Level 1 to Level 6 as L1, L2, L3, L4, L5, and L6, respectively.

Table 2.

An Example of Problems Analysis (Coding) (Külköylüoğlu et al., 2023, p. 108)

Problem: Furkan's age is 5 less than twice Feray's age. The sum of their ages is 16. Write an equation that represents Feray's age.

Solution: Let Feray's age be x .

Then, Furkan's age is $2x - 5$.

The sum of their ages is: $2x - 5 + x = 16$

$$3x - 5 = 16$$

Content

Change and Relationships (Code: C1). The category of change and relationships encompasses algebraic expressions, equations, inequalities, and the functions and algebra topics represented through tables and graphs. Since the question provided is related to algebraic expressions and equations, it has been coded as C1.

Process

Mathematical Formulation of Situations (Code: P1). The mathematical formulation of situations in the process category refers to individuals' ability to demonstrate fundamental mathematical knowledge and skills in understanding, analyzing, and solving problems. The given question involves understanding, analyzing, and solving problems using basic knowledge and skills; therefore, it has been coded as P1.

Context

No Context (Code: NC). This question cannot be associated with any of the personal, occupational, societal, or scientific contexts categorized under context. Thus, it has been coded as NC to indicate the absence of any contextual relationship.

Level

Level 2 (Code: L2). Students at this level are capable of solving simple problems by using fundamental mathematical concepts and procedures. Since the given question involves the use of basic mathematical procedures to solve a simple problem, it has been coded as L2.

Validity and Reliability of Data

Ensuring the validity and reliability of the data was fundamental to this study. Validity was bolstered by aligning the coding criteria with the comprehensive dimensions of the PISA Mathematical literacy framework and by obtaining expert reviews to confirm appropriate coverage and construct representation. Reliability was assessed through percentage agreement and statistical indices such as Cohen's kappa and Krippendorff's alpha, which account for chance agreement. The high initial agreement rates, combined with stable reliability coefficients (e.g., Krippendorff's $\alpha > .80$), indicated the consistency of the coding process (Cohen, 1960; Krippendorff, 2019). Additionally, the reliability coefficient proposed by Miles and Huberman (1994) was calculated, resulting in a value of .84, reflecting the acceptability of coding decisions. Iterative refinement and expert reviews further strengthened the overall validity and reliability of the findings, ensuring that the study's results are grounded in a robust and methodologically sound coding framework.

Findings

Findings for Analysing the Problems in the Fifth Grade Textbook

After analyzing the problems in the fifth-grade textbook according to content, mathematical processes, context categories, and PISA proficiency levels, the structure of the problems was also examined. The findings from this comprehensive analysis are detailed below.

Table 3.

Distribution of Problems in the Fifth Grade Textbook According to Content, Process and Context Categories and Proficiency Levels

Category	Proficiency Levels						Total
	1.level	2. level	3. level	4. level	5. level	6. level	
Content							
Change and Relations	14	60	25	16	0	0	115
Space and Shapes	4	17	18	14	0	0	53
Quantity	17	61	40	9	1	0	128
Uncertainty and Data	4	8	25	13	0	0	50
Total	39	146	108	52	1	0	346
Process							
Mathematical formulation of situations	20	87	9	8	0	0	124
Using mathematical concepts, facts, procedures & reasoning	21	44	63	27	0	0	156
Interpretation, implementation and evaluation	1	12	36	17	1	0	66
Total	42	143	108	52	1	0	346
Context							
No Context	58	124	43	0	0	0	225
Personal	7	35	30	11	1	0	84
Occupational	0	0	4	0	0	0	4
Social	1	6	12	4	0	0	23
Scientific	2	5	2	1	0	0	10
Total	68	170	91	16	1	0	346

An analysis of Table 3 reveals that Level 2 problems predominate across the categories of content, mathematical process, and context. Consequently, when analyzing the fifth-grade mathematics textbook as a whole, it is evident that the majority of problems fall into Levels 2 and 3. A notable finding of this study is the scarcity of Level 5 problems and the complete absence of Level 6 problems. Below is an example of a Level 5 problem from the fifth-grade mathematics textbook.

Using the data provided below, posing a problem involving addition and subtraction of fractions and solve it.

a) $\frac{2}{5}, \frac{4}{15}$, Turkish, Mathematics, English b) $\frac{3}{14}$, Pizza

Figure 2. Example of a Level 5 Type Problem in the Fifth Grade Mathematics Textbook

When analyzing the problems in the fifth-grade mathematics textbook according to the categories of content, mathematical process, and context, significant disparities were observed in the number of problems among some subcategories. For instance, within the content category, subcategories such as 'space and shapes' and 'uncertainty and data' contained fewer problems compared to others. In terms of mathematical processes, there was a notable scarcity of problems involving 'interpretation, application, and evaluation.' Additionally, within the context category, the rarity of problems in the 'professional' context and the prevalence of non-contextual problems were particularly striking. The findings regarding the structure of the problems in the fifth grade mathematics textbook are shown in Table 4.

Table 4.

Distribution of the Problems in the Fifth Grade Mathematics Textbook According to Their Structure

Problem Type	Frequency	Percentage
Fill in the blank	73	21.1

Table 4 continuing

Matching	12	3.46
Example Problem	39	11.26
Multiple Choice	36	10.43
True-False	12	3.46
Open-ended	174	50.29
Total	346	100

As can be seen in Table 4, the problems in the fifth grade mathematics textbook consist of more open-ended problems. On the other hand, matching and true/false problems were found to be less common than the other problem types.

Findings for Analysing the Problems in the Sixth Grade Textbook

After analyzing the problems in the sixth-grade mathematics textbook according to content, mathematical process, context categories, and PISA proficiency levels, the structure of the problems was also examined. The findings from this comprehensive analysis are detailed below.

Table 5.

Distribution of Problems in the Sixth Grade Textbook According to Content, Process and Context Categories and Proficiency Levels

Category	Proficiency Levels						Total
	1.level	2. level	3. level	4. level	5. level	6. level	
Content							
Change and Relations	35	71	59	2	0	0	167
Space and Shapes	18	60	57	33	1	0	169
Quantity	83	143	52	8	0	0	286
Uncertainty and Data	59	57	54	10	2	0	182
Total	195	331	222	53	3	0	804
Process							
Mathematical formulation of situations	128	115	39	3	0	0	285
Using mathematical concepts, facts, procedures & reasoning	57	182	88	37	0	0	364
Interpretation, implementation and evaluation	10	34	95	13	3	0	155
Total	195	331	222	53	3	0	804
Context							
No context	181	287	175	46	3	0	692
Personal	5	18	25	1	0	0	49
Occupational	6	5	2	0	0	0	13
Social	1	21	14	6	0	0	42
Scientific	2	0	6	0	0	0	8
Total	195	331	222	53	3	0	804

According to Table 5, it is evident that unlike the fifth grade, the sixth grade mathematics textbooks do not contain any problems of the sixth level. Additionally, there is a higher concentration of problems at the second and third levels. An analysis of the problems within the subcategories of content, mathematical process, and context categories shows a similar distribution overall. However, it was noted that problems involving the mathematical formulation of situations are more prevalent at the first and second levels within the mathematical process category. Upon further analysis of the mathematical process category, it was observed that problems requiring the use of mathematical concepts, facts, procedures, and reasoning were more common than others. In the content category, ‘multiplicity’ emerged as the most frequently addressed area, whereas ‘change and relationships’ and ‘space and shapes’ were less commonly featured. Similar to the fifth grade, the sixth grade mathematics textbooks also exhibited a high number of problems lacking specific context. Among the context-inclusive problems, those related to personal and social issues were more prevalent, and problems associated with

scientific subjects were also notably frequent. This distribution highlights the focus areas and potential gaps in contextual application within the sixth grade curriculum, suggesting areas for further enhancement to align with broader educational goals. The results concerning the structure of the problems in the sixth grade mathematics textbook are shown in Table 6.

Table 6.

Distribution of the Problems in the Sixth Grade Mathematics Textbook According to Their Structure

Problem Type	Frequency	Percentage
Fill in the blank	53	6.59
Matching	12	1.50
Example Problem	1	0.12
Multiple Choice	239	29.72
True-False	16	2
Open-ended	483	60.07
Total	804	100

As indicated in Table 6, the problems in the sixth-grade mathematics textbook are predominantly multiple-choice. Matching and true/false problems are less common, and it was noted that the number of problems providing sample solutions is particularly limited.

Findings for Analysing the Problems in the Seventh Grade Textbook

After analyzing the problems in the seventh-grade mathematics textbook according to content, mathematical process, context categories, and PISA proficiency levels, the structure of the problems was also examined. The findings from this comprehensive analysis are detailed below.

Table 7.

Distribution of Problems in the Seventh Grade Textbook According to Content, Mathematical Process and Context Categories and Proficiency Levels

Category		Proficiency Levels						
		1.level	2. level	3. level	4. level	5. level	6. level	Total
Content								
Change and Relations		55	175	57	7	1	0	295
Space and Shapes		33	47	32	7	0	0	119
Quantity		2	7	6	3	1	1	20
Uncertainty and Data		4	30	19	16	3	0	72
Total		94	259	114	33	5	1	506
Process								
Mathematical formulation of situations	of	27	44	15	5	0	0	91
Using mathematical concepts, facts, procedures & reasoning		61	174	43	6	3	0	287
Interpretation, implementation and evaluation	and	6	41	56	22	2	1	128
Total		94	259	114	33	5	1	506
Context								
No context		50	187	90	26	0	0	353
Personal		5	53	26	9	3	1	97
Occupational		1	9	5	5	0	0	20
Social		0	18	5	5	0	0	28
Scientific		0	5	1	1	1	0	8
Total		56	292	127	46	4	1	506

An analysis of Table 7 reveals that the fifth and sixth grade mathematics textbooks predominantly contain problems at the second and third proficiency levels. However, a notable distinction is that the seventh grade mathematics textbook includes problems at the sixth level, which differentiates it from

the textbooks for the fifth and sixth grades. An example of a problem from the sixth level in the seventh grade mathematics textbook is provided below. On page 263 (see in detail), there is a problem:

What is the minimum number of unit cubes that could have been used in the structure shown above?

Figure 3. Example of a Level 6 Type Problem in the Seventh Grade Mathematics Textbook

When analyzing the problems within the subcategories of content, mathematical process, and context, it is evident that problems categorized at the second and third proficiency levels are more prevalent. Specifically, within the content category, there was a higher number of problems related to ‘change and relationships’ and fewer problems concerning ‘quantity’. Upon examining the subcategories of the mathematical process category, it was noted that there was a predominance of problems that required the use of mathematical concepts, facts, procedures, and reasoning over other types. Similarly, the seventh-grade mathematics textbooks, like those for fifth and sixth grades, contained a higher number of problems that lacked specific contexts. Among the contextually based problems, those related to personal subjects were more frequent, whereas problems related to scientific subjects were less common.

Table 8.

Distribution of the Problems in the Seventh Grade Mathematics Textbook According to Their Structure

Problem Type	Frequency	Percentage
Fill in the blank	31	6.12
Matching	6	1.18
Example Problem	191	37.78
Multiple Choice	254	50.19
True-False	5	0.98
Open-ended	19	3.75
Total	506	100

As shown in Table 8, the problems in the seventh-grade mathematics textbook primarily consist of multiple-choice problems and problems with model solutions. It was observed that matching and true/false problems are less common compared to other types of problems.

Findings for Analysing the Problems in the Eight Grade Textbook

After analysing the problems in the eighth grade mathematics textbook according to content, mathematical process and context categories and PISA proficiency levels, the structure of the problems was examined. The results of this analysis are presented below.

Table 9.

Distribution of Problems in the Eight Grade Textbook According to Content, Mathematical Process and Context Categories and Proficiency Levels

Category	Proficiency Levels						Total
	1.level	2. level	3. level	4. level	5. level	6. level	
Content							
Change and Relations	48	85	70	68	0	1	272
Space and Shapes	4	14	37	16	0	1	72
Quantity	3	0	0	7	2	2	14
Uncertainty and Data	6	43	31	16	0	1	97
Total	61	142	138	107	2	5	455
Process							
Mathematical formulation of situations	55	129	56	26	1	0	267
Using mathematical concepts, facts, procedures & reasoning	2	5	37	25	0	0	69

Table 9 continuing

Interpretation, implementation and evaluation	4	8	45	56	1	5	119
Total	61	142	138	107	2	5	455
Context							
No context	29	79	92	65	0	1	266
Personal	8	16	35	29	2	0	90
Occupational	24	47	0	2	0	0	73
Social	0	0	9	8	0	0	17
Scientific	0	0	2	3	0	4	9
Total	61	142	138	107	2	5	455

An analysis of Table 9 indicates that the eighth-grade mathematics textbook has a higher proportion of problems at the second and third proficiency levels compared to other grades. Notably, there are very few problems at the fifth and sixth levels, although the number of problems at the sixth level is slightly higher in the eighth-grade textbooks than in those of other grades. When examining the problems within the subcategories of content, mathematical process, and context, a similar distribution pattern is evident across these categories. However, the distribution within the subcategories of the context category appears to be different. Additionally, like in other grade levels, the seventh-grade mathematics textbooks contain a high number of context-free problems. The prevalence of problems relating to personal contexts is higher, while those pertaining to scientific contexts are fewer, mirroring the pattern observed in the seventh-grade textbooks. In terms of content, the analysis reveals a dominance of problems pertaining to ‘change and relationships’, with ‘quantity’ being the least addressed area. Examples of this can be seen in Table 9. On page 110 of the 8th grade textbook and page 312 of the 6th grade textbook, there are two problems as follows:

Table 10.

Example for the Mathematical Content

Content	Examples
Change ve Relations	Ancient Egypt is regarded as the birthplace of mathematics. Today, it is agreed that Egyptian mathematicians were required to master mathematics to carry out their daily governmental tasks. Every year, the Nile River would overflow, flooding the lands with water and mud. After the waters receded, the previously flooded lands had to be measured to determine the boundaries for irrigation. These surveys helped to reestablish the borders that had been erased by the floodwaters. Because landowners, who held land equal to their state duties, were mathematicians, the tasks at hand often involved mathematical calculations. However, the calculations and solutions developed by mathematicians also served various purposes, from agricultural areas to the construction of pyramids. For instance, we know that some of the tools found in the ancient Egyptian city of Alexandria are still in the British Museum today. Here is a problem from that period: A rectangular pool of water from an unknown source weighs approximately 19 kg more than it would if it were empty. What is the volume of the pool? Think about it.
Quantity	As a teacher, Ayşe wants to reward Ali and Ahmet, who performed well on the mathematics exam, with the pencils in her possession. She wants to give more pencils to Ali, who scored higher. Explain how you would distribute a total of 18 pencils between Ali and Ahmet.

When analyzing the problems within the subcategories of the mathematical process category, it was observed that the number of problems related to the mathematical formulation of situations is higher than in other subcategories. This represents a divergence from textbooks at other grade levels. Additionally, within this category, there were fewer problems focused on the use of mathematical concepts, facts, procedures, and reasoning compared to the other subcategories.

Table 11.

Distribution of the Problems in the Eight Grade Mathematics Textbook According to Their Structure

Problem Type	Frequency	Percentage
Fill in the blank	110	24.1
Matching	5	1.3
Example Problem	8	1.7
Multiple Choice	172	37.8

Table 11 continuing

True-False	6	1.3
Open-ended	154	33.8
Total	455	100

As indicated in Table 11, the majority of problems in the eighth-grade mathematics textbook are multiple-choice. There are fewer matching and true/false problems compared to other types. Additionally, one of the most notable findings from the study is the scarcity of problems that provide sample solutions.

Discussion, Conclusion and Suggestions

The primary objective of this study was to examine the extent to which middle school mathematics textbooks align with the PISA ML framework in terms of content, context, processes, proficiency levels, and problem types. The findings highlight several key issues that may limit the development of students' ML and their preparedness for international assessments such as PISA. Firstly, an imbalance in the distribution of content areas was observed. While the PISA framework assigns equal weight (25%) to each content category (OECD, 2019), one category- 'change and relationships'- tended to dominate. This suggests that textbooks do not present a fully representative cross-section of mathematical domains. Such imbalances can restrict students' exposure to a broad range of concepts and hinder the development of a well-rounded mathematical understanding. Although periodic curriculum updates and textbook revisions occur, these changes may inadvertently reinforce certain emphases while neglecting others, reducing students' opportunities to engage with a diverse set of mathematical ideas. This discrepancy highlights the need for a more balanced distribution of content in textbooks, especially when aiming to succeed in international assessments. Furthermore, this variation in content distribution across grade levels may stem from the differing number of objectives assigned to each content area in the middle school curricula. Notably, Tarim and Tarku (2022) identified that in mathematics textbooks, the 'quantity' category had the most problems, while 'uncertainty and data' had the fewest. Conversely, in our study, the 'change and relationships' category featured predominantly, with 'quantity' receiving the least focus in textbooks. These disparities might be attributed to the analysis of different textbooks or editions, as curriculum changes could alter content distribution in newer editions. These findings suggest the need for a more uniform distribution of content areas in textbook development to foster students' mathematical thinking and problem-solving skills effectively.

The findings of this study highlight the limited variety of real-life contexts presented in Turkish middle school mathematics textbooks. Although there is a predominant focus on "personal" contexts, the lack of diversity in contexts, particularly those related to occupational, social, and scientific domain may restrict students' ability to engage with a broader spectrum of real-world problems. Bingölbalı and Özşiner (2022) similarly emphasizes that mathematics textbooks often fail to include a rich spectrum of real-life applications, thereby limiting opportunities for students to tackle complex, contextually rich tasks. Incikabi, Sadak and Incikabi (2023) further observed that mathematics textbooks from Türkiye, Singapore, and Australia include only a limited proportion of problems grounded in real-life scenarios, reinforcing the evidence for the scarcity of real-life opportunities in mathematics textbook tasks. To promote ML effectively, it is essential for textbooks to integrate a broader range of real-life contexts, encompassing professional, social, and scientific domains, alongside personal contexts. Such an approach would enable students to perceive mathematics as a versatile and transferable tool applicable across various aspects of life (Gravemeijer & Doorman, 1999). While personal contexts, such as daily planning or recreation, help students solve familiar problems, occupational, social, and scientific contexts prepare them to tackle unfamiliar and complex challenges, such as those related to work, societal issues, or scientific advancements. The underrepresentation of these contexts hampers the development of adaptable problem-solving skills. A more balanced inclusion of all four context categories, as outlined in the PISA framework, would ensure that students are well-prepared to apply mathematics in both familiar and novel scenarios. This balance fosters comprehensive mathematical thinking and enhances students' readiness to navigate real-world challenges, ultimately contributing to their overall problem-solving competency and real-world preparedness.

The analysis of middle school mathematics textbooks in this study reveals a strong focus on procedural skills, such as using mathematical concepts, facts, and procedures, but also demonstrates a balanced

inclusion of higher-level cognitive tasks, aligning more closely with the expectations of the PISA 2018 mathematics framework. This finding contrasts with Incikabi, Sadak & Incikabi (2023), who reported that textbooks from three countries predominantly emphasize formulating and employing mathematical processes, while offering only a small proportion of tasks requiring interpretation, evaluation, or decision-making in real-life contexts. The broader inclusion of higher-order cognitive tasks observed in this study highlights the potential for fostering advanced problem-solving skills and mathematical thinking at a critical stage in students' education. The PISA 2018 mathematics framework advocates a balanced approach, allocating equal weight (25%) to formulating and interpreting/applying tasks and 50% to procedural skills. This balance emphasizes the integration of real-world scenarios with mathematical models and the critical assessment of solutions. While Incikabi, Sadak & Incikabi (2023) found that textbooks fall short of this vision, the results of this study suggest that textbooks can indeed align with PISA's framework by incorporating diverse contexts and cognitive demands. These findings challenge prior research on the underrepresentation of cognitively demanding tasks in educational materials (O'Keeffe & O'Donoghue, 2015; Zhu & Fan, 2006) and support the need for textbooks that promote mathematical reasoning and real-world application, as emphasized in national and international standards (NCTM, 2000). To further bridge the gap, future efforts should focus on refining textbook content to ensure consistent alignment with frameworks like PISA, fostering a generation capable of tackling complex academic and real-world challenges in an increasingly quantitative world.

When evaluating middle school mathematics textbooks against the PISA mathematics proficiency levels, a notable absence of sixth-level problems—the highest proficiency level—was observed. Problems at the fifth and fourth levels were also rarely included, with the majority of tasks corresponding to the second level, the most common proficiency level among students in Türkiye as reflected in the PISA 2018 assessment. This aligns with prior research, which consistently highlights the scarcity of higher-level proficiency problems in Turkish mathematics textbooks. Studies by İskenderoğlu and Baki (2011) and Yıldırım (2019) underscore this trend, identifying a lack of advanced problems that challenge students' cognitive skills. Similarly, Tarım and Tarku (2022) found that fifth and sixth-level PISA problems were absent, with fourth-level problems being infrequent and lower-level open-ended tasks dominating textbook content. Erkoç Özçetin (2022) further noted a predominance of low-level problems in eighth-grade textbooks and supplementary materials like EBA, highlighting a systemic gap in the inclusion of high-level mathematical challenges. Addressing this gap requires a deliberate effort to enrich textbook content with a broader range of problem difficulties. Kul, Sevimli and Aksu (2018) advocate for incorporating more high-proficiency-level problems to foster the development of advanced mathematical thinking skills among students. Enhancing the cognitive rigor of textbooks is critical not only for improving performance on international assessments like PISA but also for deepening students' overall mathematical understanding and problem-solving abilities. To achieve these goals, diversifying the complexity of problems in textbooks is essential. A well-balanced inclusion of tasks across all proficiency levels will better prepare students to tackle diverse mathematical challenges, support the development of higher-order cognitive skills, and ensure a more comprehensive and effective mathematics education. Such an approach will ultimately contribute to a more competitive and adaptable generation of learners equipped to excel in both academic and real-world contexts.

Finally, our research highlights the variation in problem structures within mathematics textbooks. While open-ended problems are initially prevalent, multiple-choice problems become dominant in later grades, accompanied by a noticeable scarcity of gap-filling problems. Findings by Kul, Sevimli and Aksu (2018) reveal that Turkish middle school textbooks primarily feature multiple-choice problems, whereas Canadian textbooks emphasize open-ended problems that require higher cognitive skills. In both contexts, matching and true/false problems are less common. This distribution may limit the development of students' mathematical thinking skills. Open-ended problems and those offering model solutions promote comprehensive reasoning and problem-solving abilities, fostering critical thinking and deeper understanding. To address this, we recommend increasing the presence of open-ended and model-solution problems in textbooks. Such changes could significantly enhance students' critical thinking, problem-solving skills, and readiness for real-world challenges, ultimately contributing to a more effective and globally competitive mathematics curriculum.

The study emphasizes the need to address students' insufficient practice with real-life problems, which limits their problem-solving abilities. It recommends enhancing the balance of ML contexts, processes, and content in textbooks and increasing tasks that foster higher-order cognitive skills. Drawing on high-performing countries like Singapore, textbooks should include problems aligned with the full PISA ML Framework, featuring real-world contexts and higher-level (levels 5 and 6) open-ended tasks. Balancing contexts such as personal, social, and scientific scenarios will help students relate to familiar experiences while developing critical skills. Supporting teachers' professional development and revising textbooks to reflect these changes will strengthen students' mathematical foundation and improve international assessment performance.

Limitations

This study focused solely on the content of textbooks from one academic year and did not investigate classroom implementation, teacher interpretations, or supplementary materials. Future research could explore longitudinal changes in textbook design, the role of teacher professional development in improving task quality, or cross-country comparisons to identify international best practices that could guide local reforms.

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Investigating The Effect of Artificial Intelligence-Based Tools on Pre-Service Mathematics Teachers' Concept Images

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Abstract

Artificial intelligence (AI) and AI-based tools (AIBTs) are becoming increasingly important in mathematics education because of their potential to enrich learning experiences, provide customized solutions, and increase the effectiveness of learning processes. This case study was conducted to investigate the impact of AIBTs experiences on the mathematical concept images of pre-service mathematics teachers (PMTs). The study examined changes in PMTs' concept images of rational number, equation, quadrilateral, limit, derivative, and continuity concepts. 12 PMTs participated in the study. As a result of the content analysis, the data were categorized under the themes of component, understanding, and association, and the changes in PMTs' concept images after their ChatGPT experiences were examined according to these themes. Despite not being always, the ChatGPT experience had an effect on PMTs' mathematical concept images in general. In particular, PMTs mentioned more components directly related to mathematical concepts, while associating related concepts with different terms decreased. However, there were partial transformations in concept understanding. While subjective knowledge of concepts decreased, objective and directly related knowledge increased, but unnecessary repetition decreased. In conclusion, ChatGPT experiences contributed to the development of PMTs' concept images, but this contribution was not at the same level for all concepts.

Keywords: Artificial intelligence (AI), chatGPT, chatbots, concept images, pre-service mathematics teachers.

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Introduction

In recent years, AI and AIBTs have spread rapidly and become an important part of our daily lives. This rapid spread is driven by various factors, such as fulfilling, facilitating, and accelerating people's needs, which directly and profoundly affect human life (Chen et al., 2020; Luckin et al., 2016). While AIBTs attract attention with their potential to do more work in less time and increase productivity, they also open new horizons with the opportunities they offer (Adamopoulou & Moussiades, 2020; Sindermann et al., 2021). However, the transformation of AI does not only affect working life, but also deeply affects the daily lives and social relationships of individuals as part of society. Many tools and applications that we use every day, such as smartphones, digital assistants, and smart home appliances, are an indication of how integrated AI technologies are in our daily lives (Al Darayseh, 2023; Kim & Kim 2022; Lee & Yeo, 2022; Sindermann et al., 2021). As an important part of today's rapid technological advancements, AI technologies have the potential to provide smarter, more innovative, and more efficient solutions, which could lead to their wider adoption and integration into daily life in the future (Gökçearsan et al., 2024; Hwang & Tu, 2021). In this context, it can be said that recognizing the changes that AI can bring and developing the skills to adapt to these technologies are becoming increasingly important in our time.

Components of AI Technology

AI, machine learning (ML), and deep learning (DL) are closely related concepts that are often confused with each other (Figure 1) (Chen et al., 2020; Theodosiou & Read, 2023). AI is the field of computer science that can recognize data such as text, visual, or audio data, perform tasks such as making inferences and decisions based on this data, and mimic human intelligence (Luckin et al., 2016; Yang et al., 2021). Since AI applications are often based on the process of learning from and making sense of large data sets and the patterns formed by these data, it can be said that the organization and processing of this data is an important place for AI. Big data science is used to organize and transform large amounts of structured or unstructured data into valuable information (Luckin et al., 2016). ML involves the processes of discovering relationships between organized data, searching for patterns, modeling, and making predictions and decisions based on these models (Chen et al., 2020; Luckin et al., 2016). DL, on the other hand, focuses on the ability to learn complex patterns and relationships using multi-layer artificial neural networks (Chen et al., 2020). In this process, DL is a more complex and sophisticated form of ML as it can analyze and interpret large amounts of data using different ML approaches such as supervised, unsupervised, and reinforcement (Theodosiou & Read, 2023). These fields are intertwined and interrelated, and AI is an umbrella term that generally encompasses all of them. The ultimate goal in the development of AI is to create systems that can think and make decisions like humans (Chen et al., 2020; Luckin et al., 2016).

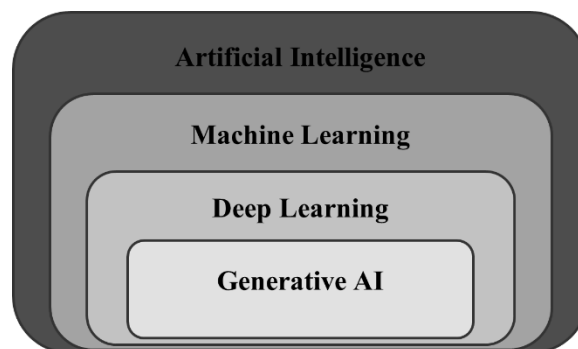


Figure 1. The relationship between AI, ML, DL and generative AI (Adapted from Theodosiou & Read [2023]).

One of the important factors for AI to enter our lives so quickly is AI-based chatbots (AICBs). AICBs are customized AIBTs, and they are generally AI programs that engage in text-based interactions with humans using natural language processing technologies (Deng & Yu, 2023). AICBs have become popular because they offer many benefits to users and developers, such as productivity, entertainment, social communication, and the ability to generate customized and quick responses (Adamopolou &

Moussiades, 2020). Alexa developed by Amazon, Siri developed by Apple, smart assistants on smartphones, chatbots developed by companies to interact with customers are the first examples of AICB, but ChatGPT developed by the company OpenAI has revolutionized AICB (Küchemann et al., 2023; Tapan-Broutin, 2023).

ChatGPT, which was developed using large amounts of text data in its training, is a language model for understanding and generating text-based conversations that can be used in various natural language processing tasks (Küchemann et al., 2023; Lee et al., 2024; Tapan-Broutin, 2023). However, the latest version of ChatGPT, ChatGPT 3.5, has added image processing and generation capabilities, as well as textual content. In addition to ChatGPT, Gemini (formerly known as Bard) developed by Google AI and Copilot developed by Microsoft are increasing competition in the field of AICBs with their important features. Thanks to its ability to generate content, it can create content ranging from poems to stories, from codes to songs, and can also help with writing. With these features, it can be said that the purpose of AICBs in the most general sense is to meet the needs of users by communicating with them through written, verbal or visual means.

AIBTs are designed to help us, but they may not always meet all of our needs due to their various limitations. In order to use these tools for their full potential, it is important to understand their limitations and the implications of these limitations. The most important of these limitations is their ability to understand and express what is written or said. Although they are improving day by day, they may still have difficulty in interacting with people or making incorrect inferences (Kim & Kim, 2022; Park & Manley, 2024). To minimize these limitations in understanding and expression, instructions must be clear and unambiguous. Another limitation relates to issues such as confidentiality and security of data, which are necessary to protect user privacy. Therefore, transparency and accountability are important factors to consider to ensure the trustworthiness of AI systems (Nguyen et al., 2023). Apart from these, dependence on limited data, bias, misinterpretation, generation of data and results that are not real, lack of emotional intelligence, cultural and linguistic deficiencies are some of the other limitations of AIBTs (Akgun & Greenhow, 2022; Gökçearslan et al., 2024; Küchemann et al., 2023; Tapan-Broutin, 2023; Uğraş & Uğraş, 2025). Uğraş et al. (2024) argue that limitations such as reliability, accuracy, and ethics may raise concerns, and therefore the literacy of individuals regarding AI and AIBT should be developed.

The Role of AI-Based Tools in Mathematics Education

Research shows that AIBTs have significant potential to increase efficiency and innovation in various fields (Hwang & Tu, 2021; Deng & Yu, 2023). In education, these tools are characterized by their ability to transform learning processes (Gökçearslan et al., 2024; İpek et al., 2023; Taani & Alabidi, 2024; Uğraş & Uğraş, 2025). AIBTs offer various functions in education, including early identification of students' needs, generating complex and detailed answers, personalizing learning experiences, creating materials, assessing and evaluating, summarizing, and rewriting (İpek et al., 2023). However, despite these possibilities, they also have certain limitations. For example, due to their inability to consistently verify sources of information, AIBTs run the risk of generating misinformation, potentially leading to misconceptions among students (Uğraş & Uğraş, 2025). Although they can provide personalized responses, their limited adaptability to individual learning needs and challenges in solving creative problems may negatively affect the learning process (Wardat et al., 2023). In addition, effective use of AIBTs without teacher guidance can be challenging, and these tools may have limitations in aligning with curricula (Uğraş & Uğraş, 2025). Therefore, caution and necessary measures are essential when using these tools considering their potential to generate incomplete, incorrect, or misleading information (İpek et al., 2023).

Mathematics education is one area that could significantly benefit from this change. This is because mathematics education is a multifaceted process that aims to concretize abstract concepts, develop skills to tackle complex problems, and enhance analytical thinking skills (Jablonka, 2020; Skovsmose, 2020). In other words, mathematics encompasses both computational aspects, such as problem solving, and conceptual understanding, as it seeks to uncover the fundamental principles that govern the relationships between mathematical objects (Skovsmose, 2020). Thus, mathematics education aims

to ensure that students effectively learn mathematical concepts and relationships (Jablonka, 2020; Skovsmose, 2020). This includes fostering students' mathematical thinking skills, enabling them to grasp abstract concepts, and strengthening their problem-solving abilities. In this process, the use of various tools, such as concrete materials, models, virtual manipulatives, and dynamic geometry software, can enhance the quality and effectiveness of education (Jablonka, 2020; Skovsmose, 2020). AIBTs are among the tools that have gained prominence in mathematics education and have significant potential to contribute to the field (Hwang, 2022; Park & Manley, 2024; Taani & Alabidi, 2024; Wardat et al., 2023).

AIBTs can make mathematical learning experiences more effective and personalized by addressing individual student needs and helping teachers enrich instructional content (İpek et al., 2023; Taani & Alabidi, 2024; Vaskoglou & Salem, 2020). Exploring how AIBTs can enhance mathematical understanding and skills provides valuable insights for evaluating their potential in mathematics education. AIBTs can provide opportunities to enhance and enrich the learning environment in mathematics education by promoting effective and interactive learning processes. This is because these tools can respond to the individual needs of students with dynamic content, customized learning materials, and content appropriate to the student's level (Celik, 2023; Taani & Alabidi, 2024; Uğraş, 2024).

Furthermore, through their ability to personalize interactive instruction, AIBTs can support the understanding of abstract mathematical concepts in a tangible way by providing tailored responses (Deng & Yu, 2023; Hwang & Tu, 2021). By increasing student motivation and encouraging active participation, these tools can also provide significant benefits to teachers in classroom management, assessment, and feedback processes (Taani & Alabidi, 2024; Tapan-BROUTIN, 2023). As a result, AIBTs can help make learning environments more dynamic, student-centered, and efficient (Deng & Yu, 2023; Hwang & Tu, 2021; Luckin et al., 2016; Taani & Alabidi, 2024; Zafari et al., 2022). Therefore, AIBTs have the potential to improve mathematics learning and teaching by enhancing students' understanding of mathematical concepts and developing their skills (Gökçearslan et al., 2024; Hwang, 2022; Hwang & Tu, 2021; Mohammed et al., 2022; Samuelson, 2023).

AIBTs also have significant potential to support the professional development of mathematics teachers and PMTs by providing a variety of information, methods, approaches, and content. These tools can enable teachers to enhance their pedagogical competencies, discover new teaching strategies, develop appropriate solutions to students' needs, and implement more effective methods in mathematics education (Al Darayseh, 2023; Taani & Alabidi, 2024; Tapan-BROUTIN, 2023). Together, these factors can help improve the quality of mathematics instruction, benefiting both teachers and PMTs (Küchemann et al., 2023). Studies generally show a positive relationship between the use of AIBTs in mathematics classrooms and student achievement, demonstrating that AIBTs can positively impact mathematics learning and serve as valuable tools in mathematics education (Hwang, 2022; Hwang & Tu, 2021; Lee et al., 2024; Park & Manley, 2024; Samuelson, 2023; Wardat et al., 2023).

Concept Image in Mathematics Education

While the possibilities offered by AIBTs in mathematics education enrich the learning process, they also raise questions about how students make sense of and construct mathematical concepts. In this context, understanding the aspects of mathematical learning based on mental processes can make the teaching process more effective. Concept image provides an important framework for understanding how a mathematical concept is represented in individuals' minds and the effects of this representation on learning (Tall & Vinner, 1981).

In general terms, the concept image is a cognitive structure that includes all the images, relationships, and processes in the mind about a concept (Tall & Vinner, 1981, p. 152). In this context, Vinner (1983) mentioned the mental picture of the concept in relation to the concept image. A mental picture is a set of visuals, symbols, meanings and relations associated with a concept. These mental picture sets form the individual's concept image of the concept (Vinner, 1983). Concept definition is the words we use to specify, distinguish, or explain a concept (Tall & Vinner, 1981, p. 152). These words are used to express the concept directly rather than indirectly (Vinner, 1983). However, the concept

definition can be considered within the concept image because each individual creates his/her own concept image with a concept definition (Tall & Vinner, 1981). Furthermore, considering that concepts consist of cognitive structures or processes, it is possible to speak of images of a concept rather than a single image (Tall & Vinner, 1981; Vinner, 1983).

Concept definitions and concept images of many mathematical concepts have been investigated in mathematics education. Studies have generally been interested in uncovering participants' concept images of mathematical concepts. Prihandhika et al. (2022) showed that PMTs' concept images of the concept of derivative are still limited to functional representations, and they usually use the concept of derivative to solve procedural problems. When engineering and mathematics students' concept images of the concept of derivative are compared, mathematics students generally perceive the derivative as a tangent, while engineering students perceive it as a rate of change (Bingolbali & Monaghan, 2008). A study comparing PMTs' concept images of fractions and rational numbers showed that they mostly have a part-whole image for fractions, a ratio image for rational numbers, and an image that fractions cannot be negative (Macit & Nacar, 2019). In addition, studies have been conducted to examine the accuracy of participants' knowledge of mathematical concepts by examining their concept images. Köğçe (2015) stated in his study that PMTs had difficulty in defining rational numbers, with one in two PMTs misidentifying the set of rational numbers and not knowing the necessary conditions for a rational number. He also found that they had difficulty in defining the concept of equation and that they often used incomplete or incorrect expressions such as 'a system for finding the unknown using the known', 'algebraic expressions with variables or unknowns', 'finding the unknown', 'mathematical equations or inequalities'. Sulastri et al. (2021) examined the concept images of limit and found that the formal definition of limit is not fully understood and, as a result, limit is defined as an unreachable function.

The study of concept images in mathematics education can highlight how individuals perceive and internalize mathematical concepts, revealing both strengths and limitations in their understanding. In this context, we think that the integration of advanced tools such as AIBTs into mathematics education may offer promising solutions for the development of accurate and comprehensive concept images. This is because AIBTs have the potential to influence how mathematical concepts are mentally understood and represented through dynamic explanations, personalized feedback, and the ability to provide contextualized examples (Taani & Alabidi, 2024). This connection provides the basis for examining the role of AIBTs in shaping PMTs' concept images, an area that brings together the fields of mathematics education and artificial intelligence to address critical pedagogical challenges.

Significance and purpose of the study

AIBTs such as ChatGPT have the potential to contribute to education in several areas, such as analyzing students' needs, providing personalized learning experiences, and providing feedback (İpek et al., 2023). In mathematics, it is found that AIBTs can be useful for problem solving, explaining complex mathematical relationships, making sense of abstract mathematical concepts, and relating mathematical concepts to everyday life (Gökçearsan et al., 2024; Hwang, 2022; Hwang & Tu 2021; Mohammed et al., 2022; Samuelson, 2023). It can be said that these opportunities offered by AIBTs in mathematics education are basically related to mathematical concepts and concept images of these concepts. This is because mathematics learning is related to the mental representations associated with mathematical concepts and the concept images that encompass them (Tall & Vinner, 1981). From this point of view, we can talk about the potential of AIBTs to affect the concept images of mathematical concepts. In this context, the aim of our study is to investigate the effect of AIBTs on concept images of mathematical concepts. The study was conducted with PMTs because they are the individuals who will effectively use mathematical concepts in both learning and teaching processes. Mathematical concepts and concept images of these concepts have a critical importance not only for pre-service teachers' own learning processes, but also for the knowledge and skills they will transfer to their students in the future. In this context, the research question of our study is: "How do AIBTs affect PMTs' concept images of mathematical concepts?"

Understanding how AIBTs influence the formation and development of concept images of mathematical concepts can provide valuable insights for both teacher education and the integration of technology into learning environments. Therefore, this study is important in that it focuses on the intersection of artificial intelligence and mathematics education and investigates the potential effects of AIBTs on mathematics education. It is also expected to provide a perspective on how AIBTs can support or enhance the teaching and learning of mathematical concepts.

Method

The research has a case study design, which is one of the qualitative research methods. Case study is a qualitative research design that aims to comparatively examine and interpret one or several well-defined situations based on the data obtained through various data collection methods (Creswell, 2012; Yıldırım & Şimşek, 2016; Yin, 2012). In the present study, "the effect of ChatGPT on PMTs' mathematical concept images" was investigated. This situation to be investigated was determined as the unit of analysis of the study. For this reason, the research has a holistic single-case design. The holistic single case design is a case study design in which the unit of analysis determined within a context is examined in detail as a whole (Yin, 2012).

Participants

The study was conducted in a state university in the Central Anatolian region of Turkey in the fall semester of 2023-2024. The students were selected among the students of the Faculty of Education, Elementary Mathematics Teaching undergraduate program of the university. Convenience sampling was used to select the participants. Convenience sampling is a sampling method in which the participants are selected from the environment that is close and easily accessible (Yıldırım & Şimşek, 2016). In addition, it was determined as a prerequisite that the students who would participate in the study had taken or were taking the "Computer Assisted Mathematics Teaching" course. This was because it was believed that the knowledge and skills acquired by the students in this course would facilitate the use of AIBTs in accordance with the objectives of the research. In this case, in order to fully evaluate the research results, a total of 12 PMTs (5 female, 7 male) participated in the study, four each from the second, third, and fourth years. First-year students were not included in the study because they were not currently enrolled in the Computer Assisted Mathematics Teaching course. In addition, the PMTs' participation in the study was voluntary.

Data Collection Instruments

Two data collection instruments were used in the study. The first is the Mathematical Concepts Form (MCF), which contains mathematical concepts. The MCF contains a total of six mathematical concepts and two questions related to each concept. Three of the concepts are "rational number", "equation", "quadrilateral", which are important and widely used in secondary school mathematics. The other three questions are "limit", "derivative", and "continuity", which are commonly used concepts in calculus classes. For each concept in MCF, the questions were "define the concept" and "what do you know about the concept, explain?". ChatGPT-3.5, developed by OpenAI, was used as the AIBT in the study. The participants conducted their research on the concepts in MCF using ChatGPT. The other data collection tool is the interview form used in semi-structured interviews. The interview form elicited the participants' experiences with ChatGPT. The form contained two questions: "Did ChatGPT give you information about mathematical concepts that you did not know? What were these questions?" and "What do you think about the usability of ChatGPT in the mathematics classroom?"

Data Collection Process

Prior to the data collection process, the participants were trained together on how to use ChatGPT. The training included information about what ChatGPT is, how it works, and what prompts it provides.

Then, all participants were asked to simultaneously learn a mathematical concept from ChatGPT that would not be used in the study. At this stage, the aim was for all participants to gain knowledge and experience about ChatGPT. The data collection process was carried out in five stages (Table 1).

Table 1.
Data Collection Process

Time	Process	Operation
Week 1	ChatGPT Tutorial	Collectively in one session
Week 1	Written reply to MCF (S1)	Collectively in one session
Week 2	ChatGPT experiences	Collectively in one session
Week 3	Written re-reply to MCF (S2)	Collectively in one session
Week 4	Semi-structured interview	Individual

In the first phase, each participant answered the MCF in writing. In the second phase, they were asked to make inquiries about the mathematical concepts in the forms via ChatGPT. There were no restrictions in this questioning process. In the third phase, they answered the MCF again. Finally, semi-structured interviews were conducted about their experiences with ChatGPT. Each of these phases was conducted in different sessions and over a period of 4 weeks. All steps of the data collection process took place in the computer lab. However, the participants only had access to the computer during the ChatGPT experiences. Except for the interviews, each session was conducted collectively at one time. Interviews were conducted individually and lasted 5-10 minutes. Participants' ChatGPT accounts were created separately for each participant by the researcher.

Data Analysis

Content analysis was used to examine and analyze the collected data. The purpose of content analysis is to organize the collected data in a detailed and systematic way and to reveal and define the relationships between the data with an inductive approach (Yıldırım & Şimşek, 2016). The data collected in this context were first made suitable for research. The interviews were transcribed, the participants' correspondence with ChatGPT was collected in a single file, and the MCFs completed by the participants before and after their ChatGPT experiences were collected. All the organized data were put into one file so that the data could be compared.

Each participant's data was compiled into separate Excel files, and content analysis was performed in MAXQDA qualitative analysis software. No coding framework was created prior to content analysis. The words and word groups that appeared to be meaningful from the participants' statements about the related concepts were first coded in vivo. After the initial coding, the in vivo codes that were thought to be related were grouped together and the groups were coded. As a result of the examination of the codes obtained, the codes that were thought to be related were grouped and themes were obtained. This process was done separately for each concept.

In order to compare the participants' concept images before and after their ChatGPT experience and to examine possible changes as a whole, the MCFs completed by the participants before the ChatGPT experience were labeled Session 1 (S1), and the MCFs completed after the ChatGPT experience were labeled Session 2 (S2). While the participants were labeled from P1 to P12, the form data of these users were created by writing the label of the application file at the end of the user label. For example, the label P1S2 was used for the data of participant 1 in session 2. Interview data were used to support the MCF data.

For example, P7 used the following expression for the concept of derivative in Session 2 (P7S2): "The rate we get as a result of this change gives us the derivative. When we take the derivative of a graph, it gives us the slope for that point. In this statement, "The rate we obtain as a result of this change" was coded as change rate; "a graph" was coded as graphic; "that for point" was coded as one point; "the slope" was coded as slope. Since the concept of derivative is associated with the concepts of slope and graph, these codes were classified under the association theme. Since the change rate is a part of the derivative process and point is an important component of the derivative, these codes were classified under the component theme.

Content analyses were conducted separately for the MCF data from S1 and S2. To determine the possible changes in the concept images of the ChatGPT experiences, they were combined into a single visual graph. The common codes in the visuals were linked to both sessions, while the codes observed in one session were linked to the corresponding session. While the codes were linked to the sessions, the themes in which the codes were found were indicated in color. Accordingly, codes belonging to the component theme were colored orange, codes belonging to the understanding theme were colored purple, and codes belonging to the association theme were colored green.

Validity and Reliability

There are different perspectives for analyzing the validity and reliability of qualitative data (Creswell, 2012). In this study, validity and reliability were analyzed based on the criteria established by Lincoln and Guba (1985). Lincoln and Guba (1985) assessed the validity and reliability of data through the concepts of credibility, transferability, dependability, and confirmability. In this study, the content of the data collection instruments, the data collection process, the data organization, and the data analysis process were explained in detail. The codes and themes obtained in the data analysis were described in detail and supported by direct references. In addition, the data were re-coded by the researcher approximately one month after the initial coding. The codes that differed between the codings were evaluated separately and finalized. For example, in the first coding, the statement of P11 "... refers to a fraction, it can carry the meaning of part-whole" was coded as "part-whole relationship" in the first coding, while it was coded as "fraction" in the second coding. Afterwards, it was seen that coding the expression as a fraction was more appropriate, and the final version of the coding was made. A more sincere and reliable research environment was created by explicitly telling the participants that the research process did not correspond to any success or grade. These actions aimed to increase the credibility, transferability, reliability, and confirmability of the study.

Results

Content analysis of participants' concept images was conducted separately for each concept. After the initial coding in the content analysis, the codes that were thought to be related were grouped. The codes for each concept were grouped under the themes of component, understanding, and association. Codes that were thought to be used in defining or constructing the related concept were grouped under the "component" theme, codes that were thought to have a special meaning for the participant about the concept were grouped under the "understanding" theme, and codes that associated the concept with other concepts were grouped under the "association" theme. For example, sample codes and user expressions belonging to these themes for the concept of rational number are shown in Table 2.

Table 2.

Examples of Themes, Codes and Participant Statements Related to the Concept of Rational Numbers

Theme	Code	Participant Statement
Component	Can be written as a/b	<i>All numbers that can be written as a/b. (P11S1)</i>
Understanding	Mathematical term	<i>A rational number is a mathematical term for all numbers between two integers. (P10S2)</i>
Association	Rate	<i>It is the rate of two numbers. (P5S1)</i>

To further examine the changes in participants' concept images before and after their ChatGPT experiences, the codes for each concept were visualized as diagrams for S1 and S2. The diagrams reflect the cognitive structures or mental models that students form about the related concepts. The common codes in S1 and S2 were visualized in relation to both documents, while the others were associated only with the relevant document. In addition, the frequency of the codes in the related document is shown on the graph. In order to increase comprehensibility, the number of common and non-common codes was limited to a maximum of five codes. To distinguish the themes of the codes in the diagrams, the codes belonging to the component theme were colored orange, the codes belonging to the understanding theme were colored purple, and the codes belonging to the association theme were colored green. In selecting these codes, the codes with the highest frequency were prioritized.

Results Related to the Concept of Rational Number

The codes associated with the concept of rational numbers are shown in Figure 2. When Figure 2 is analyzed, it is seen that both S1 and S2 associate rational numbers with other number sets such as integers and real numbers. In addition, rational numbers are associated with the concept of “fraction” and “infinity”, emphasizing “write as a/b” and “denominator is non-zero”. For example, P11 and P7 statements are given below.

“Numbers that can be written as a/b are called rational numbers.” (P11S1)

“can be written as a/b such that $\forall a \in \mathbb{N}$ and $b \in \mathbb{N} - \{0\}$.” (P7S2)

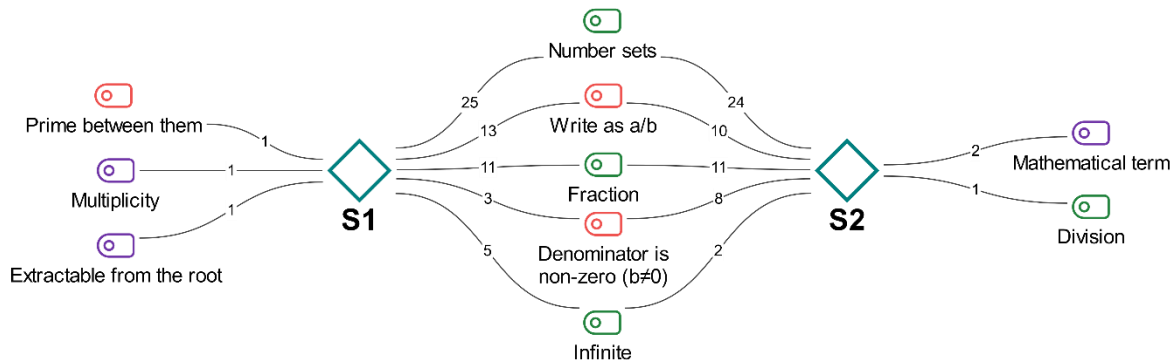


Figure 2. Codes and Frequencies of S1 and S2 Related to the Concept of Rational Number

Although the frequencies of the common codes are generally close to each other, it is noteworthy that the participants mentioned “the denominator being different from zero” more in S2. When the non-common codes were analyzed, it was observed that the frequencies of these codes were quite low. When these codes were examined, while they were associated with “being prime”, “multiplicity” and “going beyond the root” for rational numbers, they were associated with “mathematical expression” and “division” after the ChatGPT experiences. However, while there were no codes belonging to the theme of understanding in the common codes, the codes belonging to the theme of understanding in the non-common codes were more than the codes belonging to the theme of association and component.

These findings indicate a change in understanding after the ChatGPT experiences, as can be understood from codes such as associating with the concept of “infinity” and “extractable form the root”. In addition, technical details such as “denominator is non-zero” and “mathematical term” were mentioned more. P7 stated, “For example, I could not clearly remember the difference between rational numbers and irrational numbers. When I asked ChatGPT, he gave me examples to eliminate the difficulty in remembering.”. However, as can be understood from the frequencies of “fraction”, “write as a/b” and “number set” codes, it is seen that the changes in concept images are not radical and they tend to refer to similar concepts.

Results Related to the Concept of Equation

The codes belonging to the concept of equation and the diagram of the frequencies of these codes are given in Figure 3. When Figure 3 is analyzed, the codes “unknown” and “two expressions” come to the forefront in S1 and S2. These codes were the most frequently used expressions related to the concept of equation both before and after the ChatGPT experiences. In addition, while the frequencies of the other common codes are quite close to each other except for the “two expressions” code, the frequency of the “two expressions” code is significantly higher in S2 compared to S1.

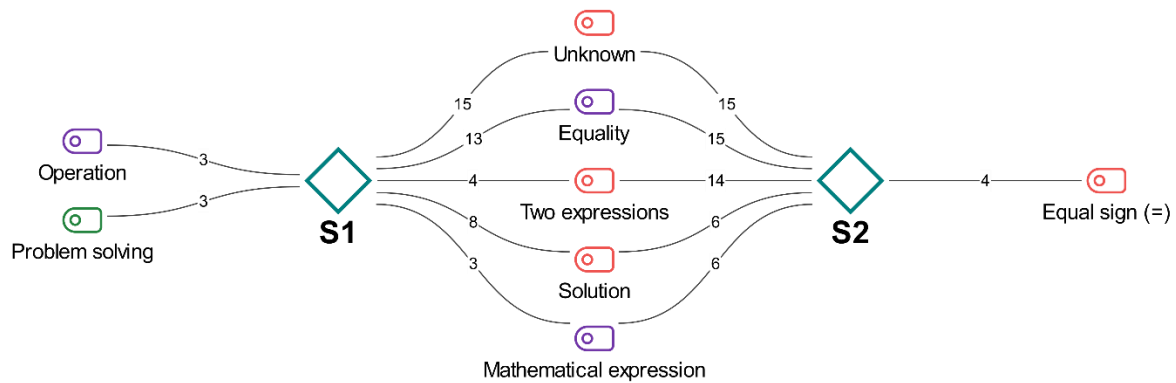


Figure 3. Codes and Frequencies of S1 and S2 Related to the Concept of Equation

When the non-common codes were analyzed, “operation” and “problem solving” codes were observed in S1, while “equals sign” code was observed in S2. However, the frequencies of these codes were not high. In addition, it is a remarkable finding that while the concept of equality was mentioned in SP1 for the concept of equation, the equal sign was not emphasized at all.

“Equal must be used. The two sides cannot be different. It must contain at least one unknown expression.” (P6S2)

Looking at the diagram as a whole, codes from the component and association themes were generally observed in relation to the concept of equation. Only in S1, “problem solving” was used for the theme of understanding. The fact that the frequencies of the common codes except “two expressions” are quite close to each other and the frequencies of the non-common codes are low shows that there is not much change in the concept images of the equation concept after the ChatGPT experience. However, the increase in the codes of “two expressions” and “equal sign” shows that the participants mentioned more important components of the equation after the ChatGPT experience.

Results Related to the Concept of Quadrilateral

The codes of the quadrilateral concept and the diagram of the frequencies of these codes are given in Figure 4. Looking at Figure 4, it was found that while the concept of quadrilateral was associated more with quadrilateral types in S1, the concept of quadrilateral was associated more with quadrilateral components such as “side” and “angle” in S2. However, although not with the same frequency as in S1, associations were made with quadrilateral types in S2. Comparing the common codes in S1 and S2, the association with “quadrilateral types” decreased after the ChatGPT experience, while the frequencies of quadrilateral components such as “edge” and “angle” increased.

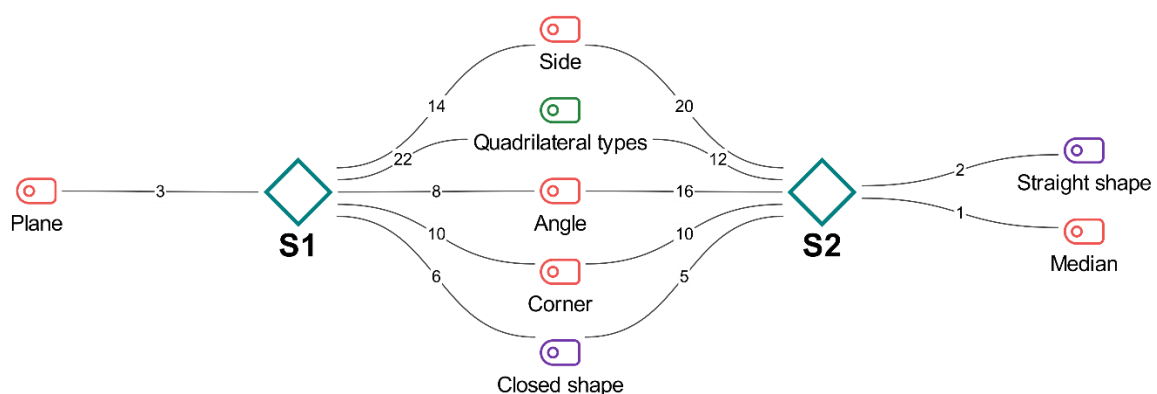


Figure 4. Codes and Frequencies of S1 and S2 Related to the Concept of Quadrilateral

When the non-common codes were analyzed, the codes "plane" in S1, "straight shape" and "bisector" in S2 were identified. At the same time, the frequencies of these codes were significantly lower than the common codes. When analyzing the whole diagram within the framework of themes, it is remarkable that the images of the quadrilateral concept are formed within the framework of the components of the quadrilateral. Moreover, in the association theme, there were only associations with quadrilateral types, while in the understanding theme, the codes "closed shape" and "straight shape" were identified. For example, P5's quadrilateral data in S1 and S2 are given below.

"It is a closed shape with four sides. There are types such as square, rectangle, equilateral, quadrilateral, etc. The sum of its interior angles is 360." (P5S1)

"It is a geometric shape with four sides and four angles. Quadrilaterals are generally classified according to their side lengths and interior angles." (P5S2)

After the ChatGPT experience, more changes were observed in participants' concept images of the quadrilateral concept compared to other concepts. After the ChatGPT experience, the components of quadrilaterals such as "side" and "angle" were mentioned more, while the types of quadrilaterals were mentioned less. However, it is noteworthy that the concept of "plane" was used only in S1.

Results Related to the Concept of Limit

As a result of the content analysis, the codes belonging to the concept of limit and the diagram of the frequencies of these codes are given in Figure 5. The analysis of Figure 5 shows that the concept of limit is generally associated with the concept of "approach". This situation applies to both sessions. However, it is noteworthy that among the common codes, there are more codes belonging to the component theme, and the frequencies of these codes belonging to the component theme increase in S2. When the common codes are evaluated together, in S1 the limit was evaluated as the approach of a point from the right and left, while in S2 it was evaluated as the approach of a function to a point. In addition, the concept of limit was associated with "indefiniteness" in both sessions.

"The value given by approaching a point from its right and left." (P1S1)

"Limit is a concept in mathematics that expresses how close the function value gets when the independent variable of a function approaches a definite value." (P9S2)

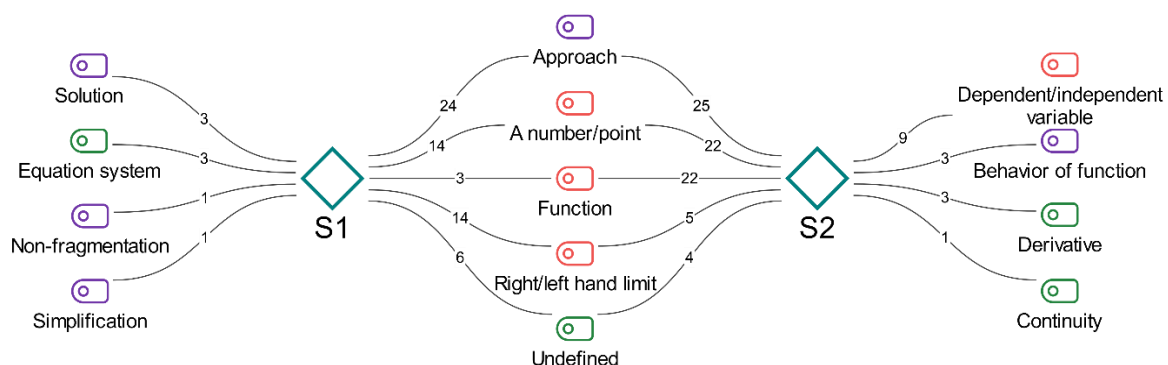


Figure 5. Codes and Frequencies of S1 and S2 Related to the Concept of Limit

When analyzing the non-common codes, although their frequency is not high, the excess of codes belonging to the theme of understanding in S1 draws attention. Here we can see that the concept of limit means "solution", "simplification" and "continuity" for the participants. In S2, the code "dependent/independent variable" stands out due to its high frequency. In addition, in S2, while limit was associated with "derivative" and "continuity", it was observed that participants had an understanding of "function behavior" related to limit. This situation shows that the concept of limit is treated in a closer relationship with the concept of function after the use of ChatGPT.

"It expresses the behavior of a function as a variable approaches a certain point." (P1S2)

After the ChatGPT experience, the participants' evaluation of the concept of limit as a function and its association with dependent/independent variables came to the fore significantly. In addition, it is noteworthy that the number of codes belonging to the theme of understanding was higher before the ChatGPT experience, but decreased significantly after the ChatGPT experience. In addition, the decrease in the association with right/left limit in S2 shows that the ChatGPT experience masked the participants' experiences with limit applications in the past.

Results Related to the Concept of Derivative

The codes of the concept of derivative and the diagram of the frequencies of these codes are shown in Figure 6. Analyzing Figure 6, it can be seen that the concept image related to the concept of derivative is more diversified in S2. When the common codes are analyzed, it can be seen that the participants associated the concept of derivative with the slope of the most frequently used function, point, and graph components. In addition, although the frequencies of the common codes are close to each other, the frequency of the "rule" code is quite remarkable in S1 compared to S2. For example, the participant expressions belonging to the "rule" code are given below.

"The derivative of unknowns of degree 1 is the coefficient of the unknown. The derivative of a constant number is 0." (P4S1)

"It is similar to minimizing a function. It is reducing the exponent by 1 and writing the exponent as a coefficient." (P12S1)

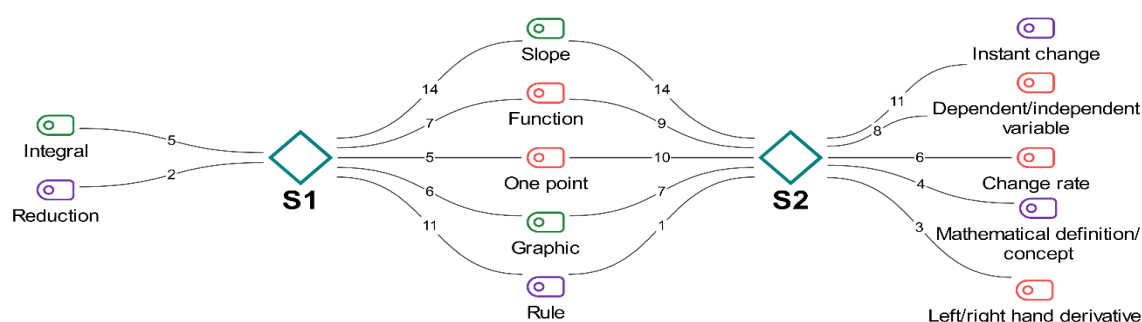


Figure 6. Codes and Frequencies of S1 and S2 Related to the Concept of Derivative

Analyzing the non-common codes, while there are fewer codes in S1, both the number of codes and the frequency of codes are quite high in S2. This is a striking result that distinguishes the concept of derivation from other concepts. Moreover, among the non-common codes in S2, no code belonging to the theme of association was observed. When analyzing the whole diagram, codes belonging to the theme of association and component were observed more frequently in S1, while codes belonging to the theme of component were observed mostly in S2. However, it can be said that the codes belonging to the theme of understanding are less than the codes belonging to other themes in both S1 and S2, both in terms of number and frequency.

It can be seen that the ChatGPT experiences were effective in enriching the participants' concept images of the concept of derivative and in enabling them to associate the concept of derivative with more mathematical concepts. A significant decrease in the rule-based explanation of the concept of derivative supports this situation. However, this is not always the case. P11's statement "I gained new information with ChatGPT, but it also reminded me of the information I had forgotten." summarizes this situation.

Results Related to the Concept of Continuity

As a result of the content analysis, the codes belonging to the concept of continuity and the diagram of the frequencies of these codes are shown in Figure 7. In Figure 7, it is noteworthy that there are more codes belonging to the component theme in the concept of continuity. However, it is

observed that in the total of both sessions related to continuity, the participants had the most understanding of breakage/rupture. Comparing the frequencies of the common codes in S1 and S2, a decrease is observed in the frequencies of the codes belonging to the themes of understanding and association, while an increase is observed in the frequencies of the codes belonging to the component theme, except for the code defined/undefined.

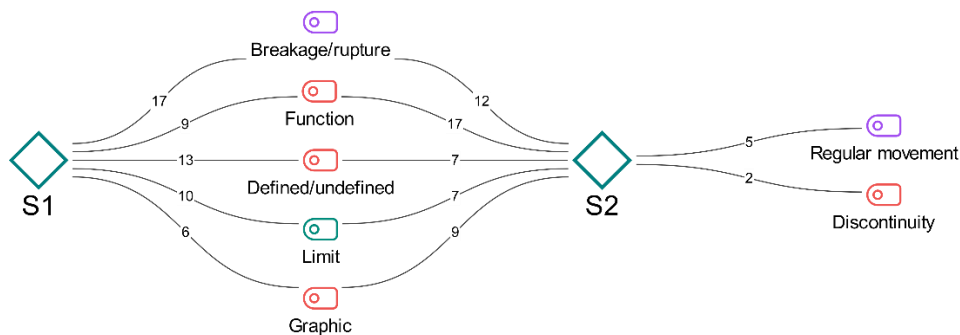


Figure 7. Codes and Frequencies of S1 and S2 Related to the Concept of Continuity

When the non-common codes were analyzed, two codes belonging to the theme of understanding emerged, namely regular movement and discontinuity. However, unlike the codes in other concepts, all of the codes in S1 were also observed in S2. The fact that the frequencies of the common codes are close and that all codes in S1 are also present in S2 indicates that the concept image for the concept of continuity is not differentiated. However, the fact that the concept of continuity was associated more with function and that it was linked to the concepts of "regular movement" and "discontinuity" may indicate that ChatGPT experiences had a partial effect on continuity concepts, although they did not affect them much.

Conclusion and Discussion

This study investigated whether AIBTs cause a change in PMTs' concept images of mathematical concepts. In this context, possible changes in participants' concept images were discussed for each concept according to the themes obtained from the content analysis. Then, from a general perspective, the effects of ChatGPT experiences on participants' concept images were evaluated.

The codes obtained from the content analysis were categorized into three themes: components, understanding, and association. When examining the components theme, it was observed that certain codes such as "equal sign" for the concept of equation, "median" for the concept of quadrilateral, "dependent/independent variable" for the concept of limit, and "rate of change," "dependent/independent variable," and "right/left derivative" for the concept of derivative were absent in S1 but appeared in S2. In addition, an analysis of the frequencies of common codes within the component theme revealed that the frequencies were generally higher in S2 than in S1. This suggests that participants may have focused on more components of the respective concept following their ChatGPT experiences. Consistent with this finding, Küchemann et al. (2023) noted that AIBTs such as ChatGPT could contribute to PMTs' conceptual understanding by helping them overcome difficulties and grasp the fundamental properties of mathematical concepts. According to Rane (2023), when used as a teaching tool, ChatGPT can be effective in teaching algebraic equations or functions. In addition, it can support mathematical learning processes by solving mathematical problems, summarizing and interpreting mathematical texts, explaining mathematical concepts, and reasoning about these concepts (Taani & Alabidi, 2024). These findings suggest that by providing foundational knowledge about a mathematical concept, ChatGPT has the potential to influence the concept images associated with mathematical concepts.

When the codes related to the association theme were analyzed, a decrease in code frequencies was observed after the ChatGPT experiences, although no significant differences were found. It was found

that the number of non-overlapping codes remained the same before and after the ChatGPT experiences, and their frequencies were similar. This might suggest that ChatGPT experiences are not very effective in helping PMTs associate a mathematical concept with others. However, Poola and Bozic (2023) emphasized that ChatGPT facilitates making connections between different mathematical concepts and topics. Frieder et al. (2023), when they examined the potential of ChatGPT as a teaching assistant, stated that although it generally understood the relevant problem, it may be insufficient in producing the correct solution. This contradiction suggests that the information provided by ChatGPT may vary depending on its intended purpose or how it is used. In this study, PMTs conducted research within a limited framework to gain knowledge about specific mathematical concepts. As a result, it can be argued that ChatGPT responses were limited to the prompts provided. This is because the responses generated by ChatGPT are directly tied to the prompts provided (Taani & Alabidi, 2024).

For the understanding theme, the number and frequency of codes related to the concept of limit decreased, while those for other concepts remained relatively consistent. Despite the similar numbers and frequencies, notable differences were observed in the codes within the understanding theme. This suggests that the ChatGPT experience may have led to a change in the PMTs' understanding of concepts. For example, for the concept of limit, "solution" was emphasized in S1, while "behavior of the function" was emphasized in S2. For the concept of equation, "operation" was emphasized in S1, while "mathematical expression" was emphasized in S2. For the concept of derivative, "rule" was salient in S1, whereas "instantaneous change" and "mathematical definition" were salient in S2. These results suggest that AIBTs may influence mathematical concept understanding and contribute to the development of concept images. Wardat et al. (2023) found that ChatGPT could provide multiple supports for teachers and students in mathematics and geometry. However, they also cautioned against accepting their responses without validation, as AI tools may misinterpret context, provide incorrect or incomplete information, and overlook pedagogical sensitivities (İpek et al., 2023). Therefore, it is crucial for teachers and students to critically evaluate the accuracy of these tools' outputs and make necessary adjustments (İpek et al., 2023; Wardat et al., 2023).

Another important consideration regarding ChatGPT's impact on concept images is whether it provided participants with new knowledge about mathematical concepts or simply reminded them of existing knowledge. The interview data revealed that some participants reported gaining new information from ChatGPT, while others stated that it helped them recall forgotten knowledge. This is consistent with the observation that AIBTs such as ChatGPT can help users recall and associate knowledge (Deng & Yu, 2023). Furthermore, ChatGPT can support learning performance by providing personalized content and guidance tailored to individual learning needs (Li et al., 2023; Uğraş & Uğraş, 2025). In this context, ChatGPT can be seen as playing two different roles: a source of new knowledge and a reminder. While in its role as a reminder, it may not have a direct impact on concept images, its role as a source of new knowledge suggests a direct impact on concept images. In either case, ChatGPT can be considered as a facilitator of learning because of the positive contributions it makes through its responses. Whether providing new information or serving as a reminder, ChatGPT was observed to play a facilitating role for PMTs (Imran & Almusharraf, 2023; Rahman & Watanobe, 2023).

In summary, although ChatGPT experiences were not always impactful, they generally influenced PMTs' mathematical concept images. Research suggests that AIBTs can improve the quality of learning by personalizing learning, providing targeted and timely feedback, and supporting educational processes (Al Darayseh, 2023; Chen et al., 2020; Ulaşan, 2023). The components directly related to mathematical concepts in ChatGPT were particularly effective in this regard. This highlights the potential of AIBTs to provide quick and effective support in educational contexts (Hwang & Tu, 2021; Ouyang & Jiao, 2021). Prior to their ChatGPT experiences, participants relied more on subjective knowledge from personal experience, whereas after using ChatGPT, they tended to explain concepts more directly and formally, reducing associative reasoning. This suggests that ChatGPT experiences generally influenced mathematical concept images, as partial transformations in understanding were observed. Given that a concept image includes all mental representations related

to a concept (Tall & Vinner, 1981), it can be concluded that ChatGPT experiences influenced participants' concept images.

In addition to contributing to concept knowledge, AIBTs can enhance PMTs' teaching skills and pedagogical competencies by providing customized recommendations based on their needs. A study by Lee et al. (2024) demonstrated the promising applicability of ChatGPT in mathematics education at both the university and K-12 levels. The research highlighted the significant benefits of integrating AIBTs into educational processes for both teachers and students. These tools provide a variety of information, methods, approaches, and content to support the professional development of mathematics teachers and PMTs (Hwang, 2022; Hwang & Tu, 2021; Mohammed et al., 2022; Samuelson, 2023). This diversity and flexibility can help teachers and PMTs increase their professional competence and confidence, ultimately contributing to improved educational quality.

Suggestions

In this section, some suggestions for the teaching process and researchers are presented based on the results obtained. First of all, the research results show that AICBs such as ChatGPT are generally effective on PMTs' mathematical concept images. Therefore, AIBTs can be included in the professional development programs of PMTs. Because these tools can play an important role in improving PMTs' pedagogical competencies and teaching skills. In addition, this study can also be conducted with mathematics teachers and students. Thus, the effectiveness of AICBs on concept images can be examined by comparing the results according to the study groups.

The results of the study showed that ChatGPT was generally effective on concept images. However, there is no clear answer as to whether this effectiveness is in terms of presenting new knowledge or reminding existing knowledge. In this context, studies can be conducted to further investigate the role and effects of ChatGPT and similar AICBs on the understanding of mathematical concepts. In addition, while the effects of AICBs on concept images were analyzed, the limitations of these tools were not included in the study. Previous studies have also mentioned the potential of AICBs to provide incomplete or misleading information (Park & Manley, 2024; Wardat et al., 2023). For this reason, it is suggested that the limitations of AICBs in the concept teaching process should be investigated. Finally, technological developments are occurring rapidly. At the time of this study, ChatGPT 3.5 had just been released, and this version was chosen because it was the most advanced one. However, new tools are being introduced day by day and existing ones are being improved. The subject of this study can be repeated with new tools other than ChatGPT 3.5 and the results can be compared.

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Investigating the Relationship Between Primary School Students' Reading Attitudes and Their Parents' Reading Attitudes

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Abstract

The reading attitudes of primary school-aged children serve as foundational elements in the lifelong learning journey, with parental influence playing a pivotal role in this process. As children's first role models, parents have the capacity to shape their children's attitudes towards reading through their own reading behaviors and attitudes. This study aims to explore the relationship between the reading attitudes of 3rd and 4th-grade students and those of their parents, assessing these attitudes across various contextual factors. The study sample includes 3rd and 4th-grade students from multiple schools located in a province within Turkey's Western Black Sea Region, along with their parents. Utilizing a correlational research design, the study employed the "Attitudes Towards Reading Scale" and "Attitudes Towards Reading Scale with Garfield Visuals" as data collection instruments. The findings indicate that female students exhibited a more positive reading attitude than male students, with no significant differences noted regarding grade level or monthly book-reading frequency. Additionally, the study observed that parents' reading attitude scores increased with higher levels of parental education and greater book-reading frequency. Correlation analysis showed no significant relationship between the children's reading attitudes and those of their parents, although a moderate positive relationship was found between the reading attitudes of mothers and fathers.

Keywords: Reading, Reading Attitude, Parental Reading Attitude.

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Introduction

Children's feelings towards reading play an important role in their reading development (Petscher, 2010). Indeed, many studies have found positive relationships between children's attitudes towards reading and their reading performance (e.g., Askov & Fishbach, 1973; Boz & Ulusoy, 2020; McKenna et al., 1995; McGeown et al., 2015). However, the fact that reading is a complex process that requires various linguistic, cognitive and affective skills (Kintsch, 1998; Spencer et al., 2020 Taboada et al., 2009; Wigfield & Guthrie 1997) makes it necessary to examine the reading experience in a multidimensional way. In this context, it is especially important to reveal the role of parents on their children's attitudes towards reading (Erdem, 2023). From this point of view, this research focuses on examining the relationship between the reading attitudes of primary school students and the reading attitudes of their parents.

Reading skills play a foundational role in individuals' personal and academic development, and this process gains even more importance with the rapidly evolving technologies of the digital age. Reading can generally be considered a process of understanding information, developing critical thinking abilities, enhancing cultural accumulation, and strengthening communication skills. There are numerous definitions of reading in the literature. Güneş (2015) and Karatay (2018) define reading as a complex process that involves the activation of visual data perceived by the eye through brain functions. This process includes cognitive processes such as attention, focus, and memory, as well as cognitive skills like making connections, comprehension, and evaluation. Therefore, reading requires not only the perception of visual data but also the processing, interpretation, and comprehension of this data.

On the other hand, Sever (2015) and Demirel (2021) emphasize that reading is an activity requiring deep intellectual effort. In this process, the reader grasps and evaluates the ideas in the text by using their grammatical knowledge, vocabulary, cultural background, and previous experiences. Demirel (2021) highlights the importance of psychomotor skills working in conjunction with cognitive processes in the reading process, drawing attention to the significance of psychomotor skills such as the eyes perceiving symbols and the vocal organs articulating these symbols. These definitions reveal that reading is not merely a physical action but also a cognitive and intellectual process.

Considering the definitions examined within the scope of reading, it is understood that the purpose of reading varies from person to person. Balcı (2016) states that although the act of reading is performed by individuals for different purposes, regardless of the purpose, it contributes to the multidimensional development and enrichment of the individual, enhancing their ability to discover and perceive the world, and thus contributes to the development of society. Therefore, reading has a significant impact not only on the individual but also on the development of the entire society. The purpose of reading is directly related to the attitude exhibited by the individual towards reading, as the individual's attitude towards reading shapes their approach to why and how reading is performed (Hood, 2015).

In the concept of reading attitude, Anderson (1988) defines the term "attitude" as a psychological construct that includes mental activities, emotional experiences, and behavioral processes observed through approval or rejection towards a particular person, group, institution, or idea (as cited in Karasu, 2013, p. 47). Attitude refers to the enduring emotional, cognitive, and behavioral tendencies that an individual develops towards a specific object as a result of environmental interactions (Başaran & Ateş, 2009, p. 77).

In the reviewed definitions, "attitude" is described as comprising three key dimensions: cognitive, affective, and behavioral. The behavioral dimension encompasses processes observable in an individual's actions, movements, responses, and interactions with their surroundings. The second includes emotional processes involving feelings, emotional responses, motivation, attitudes, and emotional experiences. The third encompasses cognitive processes involving individuals' mental activities such as thinking, learning, remembering, and problem-solving.

When examining the act of reading in terms of cognitive, affective, and behavioral dimensions, the concept of reading attitude emerges (Aranson et al., 2004). Reading attitude essentially includes the positive or negative attitudes that a person develops towards reading (Ogurlu, 2014). Reading attitude

is a concept considered to reveal the effects of reading on individuals and to evaluate reading habits, including situations such as how willing an individual is to read, how frequently they read, and how enjoyable or challenging they find reading.

Hagan (2013) defines reading attitude as encompassing the feelings that encourage the adoption of a positive reading habit or lead to the avoidance of this habit, while Vatansever Bayraktar and Açıksefer (2020) define it as the thought of a child loving a book. When the considered definitions are examined, although they approach reading attitude from different perspectives, they fundamentally emphasize the individual's cognitive and emotional attitudes towards reading.

McKenna et al. (1995, p. 939) emphasize the importance of developing a positive attitude toward reading behind individuals' increased participation in reading activities. This not only enhances personal satisfaction and enjoyment from reading but also contributes to the development of reading habits and skills. The U.S. National Research Council, as stated by Temple et al. (2005), has addressed the factors that may affect children's attitudes toward reading under four headings:

- I. **Value Placed on Literacy:** Reading books to children and encouraging reading habits help them grasp the importance of reading.
- II. **Emphasis on Success:** Parents guiding their children to enhance their achievements and supporting their interest in reading can contribute to them becoming strong readers.
- III. **Accessible and Usable Reading Materials:** The presence of children's books and other reading materials in the home environment can contribute to the development of literacy skills.
- IV. **Reading to Children:** Establishing reading routines from the preschool years is essential for parents aiming to foster a reading habit in their children. Regular participation in reading activities reinforces this habit, helping children to develop a consistent and positive approach to reading.

When looking at the factors that can affect attitudes toward reading, within the scope of the value placed on literacy, recommending that parents and educators regularly read books to children and support this activity can help children see reading as a valuable endeavor (Tanju, 2010). The emphasis on success focuses on increasing children's interest in reading by supporting their reading skills and rewarding their achievements. Providing confidence and motivation to children in reading can encourage them to trust themselves and develop their reading abilities (Yavuz, 2019).

Under the heading of accessibility and usability of reading materials, it emphasizes providing an appropriate environment for reading at home and ensuring its accessibility for children. Having a library at home for children and visiting libraries can contribute to their easy access to reading materials and the development of reading habits (Katrancı, 2019). The heading of reading to children highlights the importance of parents creating regular reading rituals to instill a reading habit and participating in reading activities. Organizing book reading times with their children and making this activity an enjoyable event can positively affect children's reading attitudes and support their reading habits (Güneş et al., 2023).

Parents have a significant impact on the positive progression of children's attitudes toward reading. Emphasizing the value of reading, encouraging reading habits, supporting achievements, facilitating access to reading materials, and providing opportunities for free choice enable children to love reading and practice regularly. Active participation of parents helps shape children's reading attitudes positively (Çelik, 2020).

Reading attitude reflects an individual's perspective on reading and influences their reading behaviors. This encompasses a person's level of interest, motivation, enthusiasm, and beliefs about reading. Reading attitude is crucial in shaping one's reading skills and in building consistent reading habits (Karadağ, 2014). For primary school children, reading habits and attitudes establish a base for lifelong learning and continuous knowledge acquisition. Within this context, the influence of parents is notably pivotal.

As primary role models, parents significantly shape children's attitudes and behaviors, including their approach to reading. A parent's reading habits and values can strongly influence a child's reading attitude. When parents engage in regular reading—whether it be books, newspapers, or magazines—and actively participate in reading activities, children are more likely to adopt a positive outlook on reading (Akyol, 2013). Observing parental enthusiasm for reading helps children perceive it as both enjoyable and valuable. Notably, when parents read in their children's presence and dedicate time to nurturing a reading habit, they inspire children to cultivate their own reading practices.

Parents' reading attitudes also affect children's reading skills and motivation. If parents emphasize the value and importance of reading and ensure that books hold a significant place at home, children become more willing and motivated to read (Baker & Scher, 2002; Gambrell et al., 1996; Henk & Melnick, 1995). Additionally, parents instilling the habit of reading books in their children helps them develop their reading skills.

By encouraging their children to read books regularly, parents support them in strengthening their reading abilities. Emphasizing the importance of reading to their children supports their school success and helps increase their academic achievements. A strong reading habit and positive reading attitude enable children to perform better at school and generally enhance their academic success. As a result, the relationship between children's reading attitudes and parents' reading attitudes has a significant impact on children's acquisition of reading habits, development of reading skills, and improvement of academic performance. Parents modeling their own reading habits and attitudes to their children positively influence children's reading attitudes, contributing to their personal development and success. Therefore, being aware of the relationship between parents' reading attitudes and children's reading attitudes and proceeding carefully in this regard is important for supporting and strengthening children's reading habits.

A review of the literature reveals numerous studies examining reading attitudes. Internationally, research often explores primary school students' reading attitudes in relation to various factors (e.g., Black, 2006; Reis et al., 2007; Yoon, 2002). Similarly, national studies on reading attitudes are abundant (Çelik, 2020; Özdemir & Şerbetçi, 2018). These studies generally aim to understand the connections between primary school children's reading attitudes and factors such as reading comprehension, motivation to read, and academic performance. The extensive range of research on reading attitudes highlights the topic's significant presence in the literature (Boz & Ulusoy, 2020; Epçacan, 2012; Kanmaz & Saracaloğlu, 2012; Karabay & Kuşdemir, 2010). However, unlike these studies, it is seen that studies on how parental support affects children's development towards reading are extremely limited (e.g., Boland & Simons, 1987; Çalışkan & Uğur, 2022; Durualp & Çiçekoğlu; Gül, 2007; Roman & Pinto, 2015).

In Gül's (2007) literature review, she states that parents' literacy experiences and attitudes have an impact on the opportunities offered to children and children's perspectives towards literacy and emphasizes that studies that mostly cover the preschool period should be focused on the primary school period. In support of this, Roman and Pinto (2015) draw attention to the importance of what parents offer their children in terms of developing positive attitudes towards reading and emphasize that systematic appreciation and recognition of the knowledge that children acquire through reading by parents can have a significant impact on their attitudes towards reading. Boland and Simmons (1987), in their project involving children aged 7-9 and their parents, showed that parental participation in reading activities positively changed both children's and parents' attitudes towards reading. In their experimental study, Çalışkan and Ulaş (2022) observed that reading activities with parental participation had a positive effect on the reading attitudes of experimental group students. Durualp et al. (2013) found that the reading attitudes of the children of middle school students whose parents read books were higher. In this context, it was stated that the positive emotional and behavioral tendency of the family towards reading activities positively affects the attitude of the child.

Despite the limited number of studies mentioned above, the lack of empirical research in the literature on the relationship between primary school students' reading attitudes and their parents' reading attitudes is striking. Gaining insights into the parental role in developing children's reading habits—and identifying the related influencing factors—is of critical importance. Beyond parents' reading habits, other factors, including family communication, socioeconomic status, and educational background, may impact this relationship. A thorough examination of how primary school children's reading attitudes correlate with their parents' attitudes represents a valuable step toward informed educational policies and fostering reading habits within families. This research aims to contribute to the development of effective strategies that encourage children's reading habits and promote positive reading attitudes.

To address this gap, the present study investigates the relationship between the reading attitudes of 3rd and 4th-grade primary school students and their parents. Specifically, it seeks to answer the following research questions:

1. Do the reading attitude scores of the participating primary school students show a significant difference according to:
 - 1.1. Gender?
 - 1.2. Grade level?
 - 1.3. Average number of books read monthly?
 - 1.4. Parents' educational status?
2. Do the reading attitude scores of the parents of the participating primary school students show a significant difference according to:
 - 2.1. Education level?
 - 2.2. Frequency of reading books?
3. Is there a significant relationship between the reading attitude levels of the participating primary school students and their parents' reading attitude levels?

Method

Research Design

The study employed a correlational research method, which, according to Karasar (2016), involves a technique to examine the relationships between two or more variables by means of comparison. This research model is particularly useful for identifying and analyzing connections among variables and is widely applied in quantitative data analysis. Through statistical techniques, it offers insights into the strength, direction, and characteristics of these relationships. For this study, the correlational research method served to explore the potential association between the reading attitudes of 3rd and 4th-grade primary school students and the reading attitudes of their parents.

Study Group

The research's target group comprises students enrolled in four different primary schools within a province located in the Western Black Sea region during the 2023-2024 academic year, along with their parents. The study group includes a total of 106 students and their respective parents, all of whom participated voluntarily. Of the student participants, 66 are in 3rd grade, while 40 are in 4th grade, with a distribution of 46 female and 60 male students. In line with the interviews conducted with the Provincial Directorate of National Education officials, it was confirmed that the schools participating in the study consisted of students with a middle socio-economic level in terms of the neighborhood they were located in. In addition, in the interviews conducted with the classroom teachers, it was decided that students diagnosed with any developmental language disorder by the Guidance Research Center (RAM) would be excluded from the scope.

Data Collection Tools

Personal Information Form: This form was prepared to determine the demographic information of parents and students. It includes demographic details such as gender, age, education level, and occupation. Additionally, the form consists of six questions specifically designed to understand whether children have their own bookshelves at home and the general frequency of reading books within the family. All information provided by each participant was kept strictly confidential and used solely to assess general trends. This approach ensured that the results obtained have a more general and valid quality.

Attitude Toward Reading Scale with 'Garfield' Visuals for Grades 1–6: To measure the reading attitudes of the participating students, the "Attitude Toward Reading Scale with 'Garfield' Visuals," adapted into Turkish by Kocaarslan (2016), was utilized. The original scale was developed by McKenna and Kear (1990) for English-speaking children. The scale comprises two sub-dimensions: enjoyment of reading (items 1–10) and academic reading (items 11–20). The internal consistency of the scale, measured by Cronbach's alpha, was found to be 0.88. The emotions included in the scale are rated from 4 to 1 using Garfield visuals representing "very happy," "slightly happy," "slightly sad," and "very sad." The highest possible score on the scale is 80, with 50 representing the midpoint.

Attitude Toward Reading Scale: The "Attitude Toward Reading Scale," developed by Çelik and Kızılaslan Tunçer (2020), comprises 35 items organized into four sub-dimensions. The first sub-dimension addresses attitudes toward developing a book-reading habit; the second centers on attitudes concerning the benefits of reading; the third relates to the parent-book dynamic; and the fourth emphasizes encouraging the child to read. In the first sub-dimension, eight items were reverse-scored for analysis. This scale is structured as a 5-point Likert-type measure, with a maximum potential score of 175. The scale's internal consistency, measured by Cronbach's alpha, is 0.80.

Data Collection Process

The researcher carried out the data collection process in two primary schools situated in the Western Black Sea Region. Prior to implementation, classroom teachers and school administrators were briefed on the research procedure. The "Attitude Toward Reading Scale with 'Garfield' Visuals for Grades 1–6" was administered to students within a classroom setting, with each session lasting approximately 20 minutes. Following the distribution of the scale, instructions were given, and students were guided to select the response that best represented their feelings for each item. For parents, the "Attitude Toward Reading Scale" was sent home with students by their teachers and subsequently collected upon return. The data collection concluded with participation from a total of 106 students and their parents.

Data Analysis

The research data were analyzed using IBM SPSS Statistics 22.0 software, beginning with assessments of data normality. To verify normal distribution, central tendency measures such as the mean and median, alongside skewness and kurtosis values, were calculated for each variable. The proximity of central tendency values and skewness and kurtosis coefficients within the acceptable range of –1 to +1 supported the assumption of normality for the data distribution (George & Mallery, 2003). This analysis was crucial to ensuring that the data met the assumptions required for parametric testing.

Reliability of the measurement scales was confirmed through Cronbach's alpha internal consistency coefficients, yielding values of 0.871 for the children's scale and 0.932 for the parents' scale, indicating high reliability. Following this, descriptive statistics, including mean ($\bar{x}$), standard deviation (SD), and frequency, were reported to provide an overview of the sample's characteristics and tendencies.

For inferential analyses, Independent Samples t-Tests were conducted to examine potential differences between groups, while One-Way Analysis of Variance (ANOVA) tests assessed variance across multiple groups. To examine relationships among variables, Pearson Correlation Coefficient analyses were employed. Where statistically significant differences were observed in ANOVA tests, post-hoc analyses were conducted using Scheffe and Tamhane's T2 tests, depending on the number of observations in groups and homogeneity of variance assumptions (Hochberg & Tamhane, 1987;

Scheffe, 1956). To interpret the magnitude of observed effects, effect sizes were calculated using Cohen's d for t-tests and Eta squared (η^2) for ANOVA, providing insights into the practical significance of the findings.

Findings

This section presents the findings related to the research questions concerning the reading attitudes of students and their parents.

Findings Related to the First Research Question

The first research question was stated as: "Do the reading attitude scores of 3rd and 4th-grade primary school students differ significantly by gender?" To answer this question, an independent samples t-test was conducted. The results are presented in Table 1.

Table 1.

Independent Samples T-Test Results for the Difference Between Reading Attitude Scores by Gender

Variable	Groups	n	$\bar{x}$	SD	t	df	p	Cohen's d
Reading Attitude	Female	46	68.28	6.63	2.693	104	.008*	0.54
	Male	60	63.75	9.82				

Table 1 highlights a clear statistical distinction in reading attitude scores between male and female students, indicating a significant gender-based difference in attitudes toward reading [$t(104)=2.693$; $p<0.05$]. Specifically, female students displayed a considerably higher mean score ($\bar{x}=68.28$) compared to their male counterparts ($\bar{x}=63.75$), with the t-test confirming this significance [$t(104)=2.693$; $p<0.05$; Cohen's $d=0.54$]. Analyzing the effect size reveals that this difference is moderate, pointing to a trend where female students generally show more positive attitudes toward reading than male students.

The second sub-question aimed to investigate whether there was a significant difference in reading attitude scores between 3rd and 4th-grade students. To examine this, an independent samples t-test was conducted, with the outcomes summarized in Table 2.

Table 2.

Independent Samples T-Test Results for the Difference Between Reading Attitude Scores by Grade Level

Variable	Groups	n	$\bar{x}$	SD	t	df	p
Reading Attitude	3rd Grade	66	65.89	8.60	.264	104	.793
	4th Grade	40	65.42	9.31			

Table 2 presents findings indicating no statistically significant difference in reading attitude scores between students in the 3rd and 4th grades, as demonstrated by the t-test results [$t(104)=.264$; $p>0.05$]. This suggests that the mean reading attitude score of 3rd-grade students ($\bar{x}=65.89$) is statistically comparable to that of 4th-grade students ($\bar{x}=65.42$). Therefore, grade level alone does not appear to influence students' attitudes toward reading in any substantial way within this sample.

The third sub-question examined whether the average number of books read per month had a meaningful impact on reading attitude scores among 3rd and 4th-grade primary school students. To explore this, another independent samples t-test was conducted, with the results displayed in Table 3.

Table 3.

Independent Samples T-Test Results for the Difference Between Reading Attitude Scores by Average Number of Books Read per Month

Variable	Groups	n	χ	SD	t	df	p
Reading Attitude	1-15 Books/Month	46	64.21	10.22	-1.539	104	.127
	16+ Books/Month	60	66.86	7.49			

As illustrated in Table 3, no significant difference was found in students' reading attitude scores when comparing groups based on the average number of books read per month [$t(104)=-1.539$; $p>0.05$]. This indicates that students who read between 1-15 books per month ($\chi=64.21$) have reading attitudes similar to those who read 16 or more books per month ($\chi=66.86$), suggesting that monthly reading volume does not substantially influence students' attitudes toward reading in this sample.

The fourth sub-question sought to determine if parental education level significantly affects the reading attitude scores of 3rd and 4th-grade students. This question was examined through a One-Way Analysis of Variance (ANOVA), with the findings presented in Table 4.

Table 4.

ANOVA Results for the Reading Attitude Scores of Children by Mother's Education Level

Variable	Education Level	n	χ	SD	F	df	p
Child's Reading Attitude	Primary	24	64.08	9.66	1.363	105	.260
	Secondary	47	67.28	7.90			
	Higher Education	35	64.74	9.35			
	Total	106	65.71	8.84			

As seen in Table 4, there is no statistically significant variation in students' reading attitude scores based on the mother's education level [$F(2, 103)=1.363$; $p>0.05$]. This outcome implies that the educational background of the mother does not appear to exert a notable impact on children's attitudes toward reading.

Furthermore, an additional One-Way Analysis of Variance (ANOVA) was conducted to determine whether the father's education level significantly affects the reading attitude scores of 3rd and 4th-grade students. The results of this analysis are presented in Table 5.

Table 5.

ANOVA Results for the Reading Attitude Scores of Children by Father's Education Level

Variables	Education Level	n	χ	SD	F	df	p
Child's Reading Attitude	Primary	12	64.67	7.16	.265	105	.768
	Secondary	65	65.49	9.00			
	Higher Education	29	66.66	9.28			
	Total	106	65.72	8.84			

Table 5 provides insight into the relationship between fathers' education levels and students' reading attitude scores, showing that no statistically significant differences were found in students' reading attitudes based on their fathers' education levels [$F(2, 103)=.265$; $p>.05$]. This indicates that the educational attainment of fathers does not significantly influence the reading attitudes of their children.

Findings Related to the Second Research Question

The first sub-question of the second research question was stated as follows: "Do the reading attitude scores of the parents of primary school 3rd and 4th-grade students differ significantly by educational

level?" To answer this question, a One-Way ANOVA was conducted. The results are presented in Table 6.

Table 6.

ANOVA Results for the Reading Attitude Scores of Mothers by Education Level

Variables	Education Level	n	χ	SD	F	df	p	η^2
Mother's Reading Attitude	Primary	24	105.13	17.56	26.489	105	.000*	0.33
	Secondary	47	122.51	15.93				
	Higher	35	137.09	16.81				
	Total	106	123.38	20.23				

* $p < .05$

Table 6 highlights a statistically significant difference in mothers' reading attitude scores that correlates with their educational attainment [$F(2, 103) = 26.489$; $p < .05$]. The Scheffe post-hoc analysis, used to pinpoint specific group distinctions, reveals that the educational level of mothers is a considerable factor influencing their reading attitudes, with an effect size ($\eta^2 = 0.33$) indicating a moderate to substantial impact. Specifically, mothers with higher education qualifications display notably higher reading attitude scores compared to mothers in the primary and secondary education categories. Additionally, mothers with secondary education levels score higher than those who only completed primary education. This pattern suggests that increased educational experience may be linked to a greater appreciation for or inclination toward reading, which can potentially translate into more positive reading attitudes. In understanding the potential impact on their children's reading development, this finding underscores the influence of maternal education. Educated mothers might model reading as a valuable activity or facilitate literacy-rich environments, thereby indirectly enhancing their children's attitudes toward reading. The observed positive correlation between higher educational qualifications and reading attitudes in mothers could imply that higher education not only broadens individual perspectives but also fosters an enduring engagement with reading.

Furthermore, a separate One-Way ANOVA was conducted to examine whether fathers' educational backgrounds influenced their reading attitude scores, aiming to uncover any potential educational impact on reading attitudes among fathers of 3rd and 4th-grade students. The results, presented in Table 7, shed light on whether fathers' educational levels similarly affect their attitudes toward reading, offering a comparative perspective to the findings observed in mothers.

Table 7.

ANOVA Results for the Reading Attitude Scores of Fathers by Education Level

Variables	Education Level	n	χ	SD	F	df	p	η^2
Father's Reading Attitude	Primary	12	114.00	22.21	4.987	105	.009*	0.08
	Secondary	65	113.20	22.07				
	Higher	29	127.34	14.88				
	Total	106	117.16	21.15				

Note. * $p < .05$

Table 7 reveals a statistically significant difference in fathers' reading attitude scores that varies with educational level, though the assumption of homogeneity of variance was not met [$F(2, 103) = 4.987$; $p < .05$]. Levene's test confirmed this variance issue ($F = 2.103$, $p < .05$), prompting the use of Tamhane's T2 post-hoc test, which is suitable for cases where variances are unequal. According to the Tamhane's T2 results, fathers with higher education levels scored significantly higher in reading attitude than those with secondary education. The effect size ($\eta^2 = 0.08$) suggests a moderate impact, highlighting that a father's level of education plays a meaningful role in shaping his attitudes toward reading. This finding indicates that higher educational attainment among fathers is associated with more positive attitudes toward reading. This trend may stem from various factors: fathers with

advanced education may have had more exposure to the benefits of reading, developed a deeper appreciation for literature, or possess greater access to resources that support a reading habit. These attitudes, in turn, may influence the literacy environment they create at home, potentially affecting their children's reading attitudes and habits. The moderate effect size suggests that while educational level is not the sole determinant of fathers' reading attitudes, it remains a relevant factor.

Moving forward, the study's second research question examines whether parents' reading attitudes vary with the frequency of their own reading habits. Specifically, the second sub-question asks if the reading attitudes of parents with children in 3rd and 4th grades differ significantly based on how frequently they read. This was assessed using a One-Way ANOVA, with the results detailed in Table 8. This analysis aims to determine if more frequent reading by parents correlates with more positive reading attitudes, reflecting how parental modeling of reading behaviors could influence attitudes and, potentially, children's literacy development.

Table 8.
ANOVA Results for the Reading Attitude Scores of Mothers by Frequency of Book Reading

Variables	Frequency of Book Reading	n	χ	SD	F	df	p	η^2
Mother's Reading Attitude	Never Reads	19	102.57	15.68	20.090	105	.000*	0.28
	0-5 Books per Month	44	123.13	15.14				
	6+ Books per Month	43	132.83	19.90				
	Total	106	123.38	20.23				

* $p < .05$

Table 8 illustrates a statistically significant variance in mothers' reading attitude scores based on how frequently they engage in reading [$F(2, 103) = 20.090$; $p < .05$]. Results from the Scheffe post-hoc test clarify these differences, showing that mothers who read six or more books per month report significantly higher reading attitude scores ($\chi = 132.83$) than both those reading 0-5 books per month ($\chi = 123.13$) and those who do not read any books ($\chi = 102.57$). Additionally, mothers who read 0-5 books per month have notably higher scores than mothers who do not read at all. The effect size ($\eta^2 = 0.28$) further emphasizes that the frequency of reading is a substantial factor influencing mothers' reading attitudes. These findings underline the role of consistent reading habits in fostering a positive attitude toward reading. Mothers who read frequently not only display a more favorable stance on reading but may also provide an enriched reading environment and act as role models, reinforcing the importance of literacy within the household.

To assess whether the reading attitude scores of fathers of 3rd and 4th-grade primary school students varied significantly based on the frequency of book reading, a One-Way ANOVA was conducted. The findings from this analysis are displayed in Table 9.

Table 9.
ANOVA Results for the Reading Attitude Scores of Fathers by Frequency of Book Reading

Variables	Frequency of Book Reading	n	χ	SD	F	df	p	η^2
Father's Reading Attitude	Never Reads	30	100.90	20.31	18.629	105	.000*	0.26
	0-5 Books per Month	56	121.00	15.69				
	6+ Books per Month	20	130.80	21.74				
	Total	106	117.16	21.15				

* $p < .05$

Table 9 reveals a statistically significant difference in fathers' reading attitude scores based on the frequency of book reading [$F(2, 103) = 18.629$; $p < .05$]. According to Scheffe post-hoc test results, fathers who do not read books scored the lowest in terms of reading attitude ($\chi = 100.90$). Fathers who read 0-5 books per month scored significantly higher ($\chi = 121.00$) than those who do not read at all. The highest scores were observed among fathers who read 6 or more books per month ($\chi = 130.80$). The

effect size analysis suggests that the frequency of book reading among fathers has a substantial impact on their reading attitudes ($\eta^2 = 0.26$).

Findings Related to the Third Question

The third research question was formulated as follows: “Is there a significant relationship between the reading attitude levels of 3rd and 4th-grade primary school students and the reading attitude levels of their parents?” Pearson correlation analysis was conducted to answer this question. The results are presented in Table 10.

Table 10.

Correlation Between Students' Reading Attitude Scores and Parental Reading Attitude Scores

Variables	1	2	3
1. Child's reading attitude	-		
2. Mother's reading attitude	.099	-	
3. Father's reading attitude	.163	.477*	-

* $p < .01$

Table 10 demonstrates a moderate, positive, and statistically significant correlation between the reading attitudes of mothers and fathers ($r = .47$, $p < .01$). However, no significant correlation was observed between the reading attitudes of the children and those of either their mothers or fathers.

Conclusion, Discussion, and Recommendations

This study sought to examine the relationship between reading attitudes of 3rd and 4th-grade primary school students and those of their parents. The research was primarily motivated by a gap in the literature, as few studies comprehensively explore the connection between primary students' reading attitudes and their parents' attitudes. Additionally, the study investigated reading attitudes in relation to variables including students' gender, grade level, monthly reading frequency, and parental education levels. Furthermore, it analyzed whether parental reading attitudes varied with their educational background and the frequency of their own reading habits. The findings, contextualized with relevant literature, are discussed below.

The analysis of reading attitude scores for 3rd and 4th-grade primary school students revealed a statistically significant gender-based difference, with female students demonstrating a more positive reading attitude than their male counterparts. This pattern is consistent with many studies in the field, which also report that female students generally possess stronger reading attitudes than males (Akkaya & Özdemir, 2013; Balcı et al., 2012; Duran & Alevli, 2014; Gömleksiz, 2004). Such findings suggest that gender may play a role in shaping students' outlook on reading from an early age, potentially due to social or developmental factors that influence girls to engage more favorably with reading activities.

Internationally, cross-sectional studies echo these findings, showing a similar trend among girls who, on average, exhibit more positive attitudes toward reading in both primary (McKenna et al., 1995) and secondary education (McKenna et al., 2012). However, it is important to note that some research reports contrasting results; for instance, certain studies have identified higher reading attitudes in male students (Altunkaynak & Çağımlar, 2021). These mixed outcomes highlight that while a positive reading attitude is frequently associated with female students, this trend is not universal. Additional research even suggests that gender may not be a determining factor at all in students' reading attitudes (Alieto et al., 2020; Başaran, 2014; Taşkın & Aygün, 2017).

The variability in these findings points to the complex and potentially context-dependent role that gender may play in students' attitudes toward reading. Cultural, environmental, and educational influences, as well as societal expectations regarding literacy, could all contribute to these differences. Therefore, while female students tend to have more favorable reading attitudes overall, it is essential to consider the influence of broader contextual factors that may either enhance or diminish gender-based distinctions in reading attitudes. Future research would benefit from examining how these contextual

factors interact with gender to shape students' engagement with reading, offering a more nuanced understanding of the role that gender plays in literacy development.

The study results showed no significant variation in reading attitudes between 3rd and 4th-grade students, indicating that reading attitudes did not necessarily improve as students progressed from one grade to the next. Ideally, it would be expected that reading attitudes become more positive with increasing grade level, as this aligns with educational objectives that encourage progressive engagement and enthusiasm toward reading. However, the lack of such an increase raises questions about factors that might be hindering students' reading attitudes as they move to higher grades. This finding aligns with recent research, which found that 3rd-grade students often exhibit slightly higher academic and recreational reading attitudes than those in 4th grade (Şahin Taşkın & Esen Aygün, 2017).

One plausible explanation for this trend relates to the developmental shift from "learning to read" to "reading to learn," which typically occurs between these grades. As students begin to use reading more as a tool for learning, the materials they encounter often become more challenging and require greater comprehension skills to extract and interpret information effectively. This increase in reading complexity may inadvertently decrease enjoyment and positive feelings toward reading, especially if students encounter difficulties or lack confidence in understanding more advanced texts (İşeri, 2010).

This pattern has also been observed internationally, with studies revealing a decline in reading attitudes as grade level increases, a trend that spans both primary and secondary education (McKenna et al., 1995; McKenna et al., 2012). This shift in attitude is a point of concern for educators and parents, as a decrease in reading enthusiasm at this critical stage could influence students' overall academic engagement and success. These findings suggest that supporting students' reading attitudes across grade levels is essential. For both educators and parents, maintaining a balance between cognitive challenges and engaging content could help preserve students' positive attitudes toward reading as they advance in school, ultimately fostering a lifelong appreciation for reading.

The study revealed no significant difference in students' reading attitudes based on the average number of books they read per month, a result that contrasts with prior research. Earlier studies with primary and secondary students have shown a moderate positive correlation between the quantity of books read and students' reading attitudes, suggesting that increased reading frequency fosters a more positive attitude toward reading. Similar findings with 6th, 7th, and 8th graders demonstrated a link between the number of pages read and a more favorable reading attitude (Akkaya & Özdemir, 2013; Baki, 2017; Özdemir & Şerbetçi, 2018). For instance, Özdemir and Şerbetçi (2018) identified a moderate positive correlation between 4th graders' reading attitudes and the number of books they read outside textbooks over a year. Another study indicated that primary students who read daily or several times a week held more positive reading attitudes (Yurdakul et al., 2020). This study's differing results may stem from the reliance on self-reported data regarding reading frequency.

The study found no significant difference in students' reading attitude scores based on the mother's education level. This finding aligns with the existing literature. Şahin Taşkın and Esen Aygün (2017) also demonstrated that parental education levels do not significantly impact students' reading attitudes. Similarly, Kuşdemir (2019) and Kandemir (2019) found no significant relationship between parents' education levels and students' reading attitudes. However, İnan (2005) and Karademir and Gürsoy (2018) reported that the education level of parents influences students' reading habits, with children of university-educated parents showing more positive reading habits. Overall, it can be suggested that, beyond the education levels of mothers and fathers, factors such as how parents support their children in reading and whether they serve as positive role models may be crucial in shaping students' reading attitudes.

The study further revealed that educational level is generally a significant factor affecting the reading attitudes of mothers and fathers. This difference is especially pronounced for mothers, with those holding higher educational qualifications showing significantly more positive reading attitudes than others. Regarding fathers, university graduates scored higher in reading attitudes than those with secondary education. Similar findings can be found in the literature. In their study, Çelik and Kızılaslan Tunçer (2020) found that reading attitudes improve as parental education level increases.

Additionally, Erdoğan and Demir (2016) concluded that there is no significant relationship between mothers' education level and their reading attitude. These findings may stem from differences in research methodologies, sample groups, and cultural factors. Some studies focus on parents' overall educational level, while others examine mothers' or fathers' educational levels separately. Other environmental or socioeconomic factors influencing reading attitudes may have also impacted the results.

A significant finding in this study is the observed difference in reading attitude scores among mothers of 3rd and 4th-grade students, depending on how frequently they engage in reading. Specifically, mothers who read six or more books each month demonstrated notably higher reading attitude scores than those who read less frequently. This trend was also present among fathers, suggesting that parents' reading frequency is positively correlated with their attitudes toward reading. These findings align with research suggesting that increased reading habits in parents are associated with more favorable attitudes toward reading (Kaya Özgül, 2023). Such results underscore the potential impact of parents' personal reading behaviors on their overall disposition toward reading, which may, in turn, influence their role as reading models for their children. This trend emphasizes the importance of fostering regular reading habits among parents to encourage a positive reading culture within the family.

To answer the study's central question, a correlation analysis was conducted to assess the relationship between the reading attitudes of 3rd and 4th-grade primary school students and their parents. The analysis indicated a moderate, positive, and significant correlation solely between the reading attitude scores of mothers and fathers, with no notable association found between children's reading attitudes and those of their parents. This outcome diverges from initial expectations. Although direct investigations into the correlation between primary students' reading attitudes and those of their parents are sparse in the literature, prior research consistently underscores the role of family engagement and parental encouragement in shaping children's attitudes toward reading. For example, studies by Durualp et al. (2013), Darıcan (2014), Kocaarslan (2016), and Şahin Taşkın and Esen Aygün (2017) highlight that parents' accumulated cultural knowledge related to reading and their behavior as role models exert a substantial influence on children's development of positive reading attitudes. This suggests that parental attitudes may play a more indirect role in shaping children's perspectives, perhaps influenced by the quality and frequency of reading interactions within the family environment.

Capotosto et al. (2017), in their study on how parents support the reading skills, motivation, and habits of third-grade students, emphasized that parent-child reading interactions are mutually influential. Similarly, a study by Stephens et al. (2015) showed that parents and children influence each other's reading attitudes and behaviors. The quality of the literacy environment at home and parents' approaches are thought to be influential in the relationship between parent and child reading attitudes. Indeed, the importance of children modeling their parents in personality development is emphasized. Aslan and Harput (2017) reported that children raised in households where reading occurs tend to develop positive attitudes and habits towards reading. However, no significant difference was found when examining the impact of specific reading hours on children's reading attitudes.

When the study's results are evaluated as a whole, the importance of both students and parents developing positive attitudes toward reading becomes apparent. A positive reading attitude among primary school students, who are in a critical stage of reading development, plays a crucial role in their academic success and personal growth. Raising awareness among parents to support their children's reading skills and fostering their understanding of this issue is essential. Positive reading attitudes among parents may indirectly promote positive emotions in their children, supporting their lifelong engagement as readers.

This study has some limitations. The sample group consisted only of 3rd and 4th-grade students, the sample size was relatively small, and the attitude scales used for reading attitudes were different for children and parents. Thus, it is recommended that the results be interpreted cautiously and that overgeneralization is avoided. Additionally, the lack of a significant relationship between parent and child attitudes in this study may be attributed to certain mediating variables not included in the

research. Future studies should consider groups with diverse and larger samples from various grade levels and include variables that may influence household literacy, such as interactive reading hours and availability of home libraries.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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The Effect of Teacher-Child Relationship on Preschool Children's School Adjustment and Behaviour Problems

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Abstract

This research has been conducted to examine the relationship between teacher-child relationships school adjustment and social competence variables. In total of 414 preschool children (216 boys, 198 girls), and their teachers participated in the study. Preschool teachers completed three questionnaires: The Student-Teacher Relationship Scale, the Social Competence and Behaviour Evaluation Scale, and the Teacher Rating Scale of School Adjustment. The relational survey method was used in this study. The results of this study show that there is a significantly positive relationship between the level of teacher-child closeness sub-dimension and social competence, school liking, classroom participation, and self-directiveness scores. In addition, there is a significantly negative relationship between the level of teacher-child closeness sub-dimension and anger/aggression, anxiety/introversion, and school avoidance scores. Further examination of the data revealed that, there was a significant positive relationship between the level of teacher-child conflict sub-dimension and anger-aggression and anxiety/introversion scores. On the other hand, a negative correlation was observed between the level of teacher-child conflict sub-dimension and social competence, school liking, classroom participation, school avoidance, and self-directiveness scores. According to the results, levels of teacher-child closeness predicted the levels of social competence, school liking, classroom participation, and self-directiveness. According to the results, levels of teacher-child closeness predicted the levels of social competence, school liking, classroom participation, and self-directiveness. Also, levels of teacher-child conflict predicted the levels of anger aggression, anxiety/introversion, and school avoidance.

Keywords: Teacher-child relationships, school adjustment, social competence, preschool.

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Introduction

Early childhood period is a sensitive time for interpersonal relationships. It is an important part of children's overall development. Research shows that children's interactions and relationships not only within the family, but also outside the family, are important for a child's wellbeing, as well as their development (Thompson, 2014). In early childhood, this is particularly true of the relationships that children have with their teachers and caregivers (Burchinal et al., 2008; Pianta et al., 2020; Pianta & Hofkens, 2023).

One of the major influences on the current views of the effects of relationships between teachers and children on their development is based on the principles of ecological systems theory. In *Bronfenbrenner's Bioecological Model* explaining environmental factors in a child's development, a child's development is affected by experiences in a series of nested systems that interact (Sabol & Pianta, 2012). These systems range from the microsystem (the immediate context), which includes the child's experiences with his or her immediate environments, such as family members, classroom, teacher, to the macrosystem (the distant context), which is the broader environment that includes cultural values and policies. The microsystem comprises interactions with the immediate environment (eg. teachers, and peers) that most strongly influence a child's development (Bronfenbrenner & Morris, 2006; Cross & Hong, 2012; Degol & Bachman, 2015; Nasiopoulou et al., 2019). From the perspective of the bioecological model, the positive dynamics between teacher and child are an essential close context that facilitates learning and development. Teachers provide children with a safe and supportive learning environment and support children's engagement in effective pedagogical practices that influence children's learning processes (Lippard, et al., 2018).

Teacher- Child Relationships

The teacher-child relationship is defined as a form of interpersonal relationship that occurs during the interaction between preschool teachers and children (Ainsworth, 1991). Theories of teacher-child interactions and various studies testing these theories show that preschool teachers have a significant impact on children's development (Ansari et al., 2022; Sutherland et al., 2018). As children transition from home to preschool, the teacher's role is not only in the context of the child's cognitive development, but also has an impact on their social development (Buettner et al., 2016; Egert et al., 2020; Lippard et al., 2018; Nguyen et al., 2020; Plotka, 2019; Rojas & Abenavoli, 2021; Sutherland et al., 2018). According to attachment theorists, positive teacher-child relationships provide children with a secure base that helps them feel safe while exploring the environment and a safe haven where children can seek support and comfort from their teachers during stressful times (Pianta et al., 2003; Sabol & Pianta, 2012; Zhu et al., 2023). In contrast, negative teacher-child relationships tend to evoke feelings of insecurity in children and therefore prevent them from exploring the environment. As a result, children who share positive relationships with teachers tend to be competent and adaptive at school, whereas negative teacher-child relationship experiences can harm children's school functioning and well-being (Pianta et al., 2003; Zhu et al., 2023).

When it comes to relationships between teachers and children, researchers often assess the degree of closeness and conflict in the relationships between teachers and children (Pianta, 2001; Saral & Acar, 2021; Settanni et al., 2015). In the current study, the teacher-child relationship was conceptualized within the scope of these two basic dimensions. Closeness reflects relational security, and children who have positive teacher-child relationships characterized by open communication based on warmth and affection tend to exhibit fewer internalizing and externalizing problems (Baardstu et al., 2022; Ferreira et al., 2016; Pianta et al., 2003; Wu et al., 2015). Research results indicated that warm, responsive, and supportive teacher-child interactions encourage children to use social-emotional skills (Bulotsky-Shearer et al., 2020; Colwell & Lindsey, 2003). Conflict is linked to relational insecurity and reflects the degree of disharmony, argumentation and negativity between teachers and children (Pianta et al., 2003; Roorda et al., 2014). Teacher-child conflict in preschool years can affect children's social skills (Graves & Howes, 2011) and school adjustment (Birch & Ladd, 1997). It may cause the child to develop negative feelings and attitudes towards school, withdraw from school, have adjustment problems at school, and develop behavioral problems (Acar et al., 2021; Acar et al., 2022;

Coplan et al., 2017; Hamre & Pianta, 2001). Negative interactions have been shown to be ineffective in helping children regulate their emotions and control behaviors (Plotka, 2019; Zhu et al., 2023).

School Adjustment

Adjustment is the process of finding a balance between children's developing personalities and the increasing demands of their environment (Saraç et al., 2023). For preschool children, getting used to the preschool environment means actively participating in the process, enjoying school and establishing healthy relationships (Birch & Ladd, 1997). Adjustment to preschool includes the acquisition of academic readiness skills, behavioral regulation at school, and social interactions with teachers and peers (Pianta et al., 1997; Yoleri, 2015). This adjustment process is important for children's development (Bornstein et al., 2010; Wu et al., 2015). Children who adapt effectively are more likely to be accepted by their peers (Dos Santos et al., 2020; Shehu, 2019; van der Wilt et al., 2019). In contrast, poor adjustment to preschool may set the stage for further social problems and school failure (Karaman, 2022; Yoleri, 2015).

An important factor in children's school adjustment is their relationship with their teachers (Birch & Ladd, 1997; Hamre & Pianta, 2001). A friendly teacher who communicates with children can help support children's adjustment to school. However, problems or miscommunication between the teacher and the child may cause the child to feel lonely at school, have negative feelings towards school and want to stay away from school (Birch & Ladd, 1997).

Social Competencies

Research shows that anger, anxiety, aggression, and introversion are among the factors that affect children's social competence in the process of developing social competence (Hanish et al., 2004). For example, anger-aggression shows externalizing behaviors such as challenging adults, acting maladaptive and aggressive, whereas anxiety-introversion shows internalizing symptoms such as children's unhappy and depressed feelings and showing shyness in a group (La Freniere & Dumas, 1996). An increase in social competence supports positive social skills and prevents situations such as withdrawal and anxiety (Gür et al., 2015; Pekdoğan & Kanak, 2016). Research shows that an increase in social competence scores positively affects attitudes and behaviors towards peers (Balluerka et al., 2023; Shehu, 2019). Juntilla et al. (2012) found that social competence skills predicted anxiety and introversion in children and adolescents. Wichstrom et al. (2013) found an inverse relationship between social competence and anxiety-introversion in their study with 1000 children.

As in the bioecological model (Bronfenbrenner & Morris, 2006), positive dynamics between teacher and child mean that the more supportive relationships teachers have with children, the greater their ability to inhibit impulsive reactions, and to change and maintain their behavior (O'Connor, 2010; Rudasil et al., 2020). Teachers play a key role in helping children develop social competencies (Goble et al., 2019; Hollingsworth & Winter, 2013; Schmitt et al., 2018). Since positive child-teacher relationships have a strong impact on children's social competencies development, there is a strong need to develop these relationships, especially from preschool period, when children come together for the first time with adults other than their primary caregivers (Pianta et al., 2003; Sabol & Pianta 2012). Therefore, teachers can be seen as a reference point for building positive relationships and initiating a stronger communication process (DeJames, 2001). Children with developed social competence have positive interactions with teachers and enjoy school and activities (Soininen et al., 2023; Loomis, 2021). On the other hand, children with inattention and impulsivity problems when they start school experience more conflicts with teachers throughout preschool (Li & Lau, 2019).

When assessing the development of children's social competencies, two general distinctions are made for social-emotional problems: externalizing problem behavior and/or internalizing problem behavior (Lilienfeld, 2003; Stone et al., 2015). Externalizing conduct problems are manifested in externalizing behaviors, including aggression and hyperactivity (Liu, 2004), while internalizing conduct problems are characterized by anxiety and depression, fear, social withdrawal, and somatic complaints (Göbel et al., 2016).

Current Study

Previous researchers have indicated that the quality of the teacher-child relationship plays an important role in children's school adjustment and social competence (Birch & Ladd, 1997; Burchinal et al., 2008; Buyse et al., 2008; Hamre & Pianta, 2001). However, negative teacher-child relationships are a risk factor for children's school adjustment and social competence (Acar et al., 2019; Murray et al., 2008). As a result, the teacher-child relationship in the early years plays a significant role in children's lives with both short and long-term effects. Therefore, it is thought that this research can contribute to the diversification of the studies conducted on the teacher-child relationship of the children in the early childhood period in Turkey.

The study aims to determine the predictive effect of preschool children's relationships with their teachers on their school adjustment and social competencies. The sub-objectives of the research are as follows:

- Is there a statistically significant relationship between teacher-child relationship and children's school adjustment and social competence skills?
- Does teacher-child relationship predict children's cooperative participation, school avoidance, self-management, and liking school at a statistically significant level?
- Does the teacher-child relationship predict children's social competence, anger-aggression and anxiety-introversion at a statistically significant level?

Method

Model

This study used the relational survey method to examine the predictive effect of student-teacher relationships on their school adjustment and social competencies. The relational survey model aims to determine the presence and level of change variance between two or more variables (Chirstensen et al., 2015).

The sample

The sample of the research comprised 414 children (216 boys, 198 girls), ages 5-6, enrolled in public preschools operating in the District of Karabağlar, Province of İzmir. There were six public preschools in Karabağlar district. All of the schools accepted the invitation to participate in the study. Our study was conducted simultaneously in six public preschools based on voluntary participation. Among the assessment instruments given to teachers regarding 700 children, 414 were filled out completely and correctly. Thus, 414 children were included in the study. The average age of the children was 5 years, 5 months, and the maximum was 6 years, 1 month. All the children showed normal development characteristics according to the teachers' views. None of the children participated in inclusive applications. All of the children live with their families. On the other hand, all the teachers involved in to study were women, ranging in age from 25 to 54, with teaching experience ranging from three to nineteen years; all teachers had bachelor's degrees.

Instruments

Data were collected with the Personal Information Form, Student-Teacher Relationship Scale-Short Form (STRS-SF), The Social Competence and Behaviour Evaluation Scale- Short Form (SCBE-30) and the Teacher Rating Scale of School Adjustment.

Personal Information Form: Questions related to such features as children age, gender, teachers' years of experience, educational status included in the form developed by the researchers.

Student-Teacher Relationship Scale-Short Form (STRS- SF) is a Likert scale consisting of 15 self-report items. Each item in the scale is coded between 1 (Definitely does not apply) and 5 (Definitely does apply) (Jerome et al., 2009;Pianta, 2001). The scale examines how the teacher perceives the student's behaviours and the student's thoughts about himself/herself, by taking into consideration the relationship formed with each student. It consists of two sub-dimensions which include closeness and conflict dimensions. Closeness sub-dimension includes attending to the needs of the child and being

responsive, being involved in positive emotional interactions with the child as much as possible (e.g., “I share an affectionate, warm relationship with this child”). The conflict sub-dimension includes negative behaviours the teacher perceives concerning the child and negative emotional interactions (e.g., “This child and I always seem to be struggling with each other”). It is stated that, while evaluating the student–teacher relationship effectively, it also provides support for the identification of teachers who are experiencing problems in communication or interaction and who are going through occupational burnout (Pianta, 2001). The adaptation of the short form used within the current study into Turkish has been completed by Şahin Ası and Ocak Karabay (2018). Its Cronbach's alpha values were .82 for the total score, .84 for the conflict sub-dimension, and .76 for the closeness sub-dimension. For the current study, Cronbach's alpha values of were .76 for the closeness sub-dimension and .90 for the conflict sub-dimension.

The Social Competence and Behaviour Evaluation Scale- Short Form (SCBE-30) for teachers was originally developed by LaFreniere and Dumas (1996). This 30-item scale for children in the 30-78 months age range is composed of three sub-dimensions: two distinct patterns of maladaptive behaviour (the Anger-Aggression or AA and Anxiety-Withdrawal, or AW sub-dimensions) and one adaptive pattern (the Social Competence, or SC, sub-dimension). The scale was completed by the children's teacher. The AA sub-dimension reflects children's angry, aggressive, and irritable behaviours. Children were evaluated as angry and aggressive who showed negative effects and was unable to regulate their negative emotions. The AW sub-dimension is composed of items that measure dependent, anxious, and isolated behaviours. These children spend much of their time alone and unoccupied and demonstrate little interest in group activities. Finally, the SC sub-dimension includes items used to assess positive social interaction (e.g., can negotiate solutions, works easily in groups) as well as prosocial behaviour/empathy toward their peers at school (e.g., cooperates, shares toys, comforts others). Socially competent children show positive affect in their interactions and are well appreciated by their peers and teachers. Responses were given on a 6-point Likert scale from 1 (never) to 6 (always). Çorapçı, Aksan, Arslan-Yalçın and Yağmurlu adapted the scale into Turkish in 2010. The Cronbach's alpha value averages for the original version of the scale were .87 for the SC, .84 for the AW, and .88 for the AA respectively (LaFreniere et al., 2002). The Cronbach's alpha for the current study was .93 for the SC, and .86 for the AW, .91 for the AA.

Teacher Rating Scale of School Adjustment for 5-6 years of developed by Ladd, Kochenderfer, and Coleman in 1996 designed to evaluate preschool children's school adjustment. The Scale included 25 items and four sub-dimensions: school avoidance, school liking, cooperative participation, and self-directiveness. Teachers completed the items using a three-point scale: doesn't apply, applies sometimes, and certainly applies (Birch & Ladd, 1997). The internal consistency scores for the original version of the scale across measurement occasions exceed .75 (Birch & Ladd, 1997). The Turkish version of the TRSSA was adapted by Önder and Gülay (2010). The internal consistency, as reported by Önder and Gülay (2010), for the whole scale was .70. In the current study, the internal reliability of the whole scale was found at .71. and the internal consistency coefficient of the sub-dimension school liking was .85, the internal consistency coefficient of the sub-dimension cooperative participation was .92, the internal consistency coefficient of the sub-dimension school avoidance was .83, and the internal consistency coefficient of the sub-dimension self-directiveness was .81.

Data collection process

The study was initiated after the approval of the institutional ethics committee at İzmir Democracy University and the Ministry of National Education in Turkey. After obtaining ethical approval, the researchers explained the purpose of the study to the school principals who agreed to participate in the study. For schools that agreed to participate, the aim and confidentiality of the study were explained to parents informed consent was obtained from parents for their participation in the study. Parents were informed that participation was voluntary and that they would not encounter any disadvantages in case of non-participation. Children were included in the study only after their parents gave written informed consent to participate in the study. The measurement tools were completed by the teachers for each child. Preschool teachers were informed about the research and data collection tools by the researchers before the implementation. Despite all efforts, only 414 surveys were found to be filled out completely and accurate. The data analysis was conducted based on this number.

Data analysis

The analysis of the data was statistically conducted with SPSS 25 programme. Correlations were tested using the Pearson correlation coefficient. A simple Linear Regression Analysis Technique was performed to determine the predictive effect of the teacher-child relationship on school adjustment and the social competence children'.

Findings

Table 1.

The means, standard deviations and correlation coefficients of the variables in this study

	M	SD	1	2	3	4	5	6	7	8	9
1. Conflict	12.40	6.51	1								
2. Closeness	31.34	4.88	-.39**	1							
3. Social Competence	45.99	11.57	-.68**	.66**	1						
4. Anger/Aggression	19.49	9.74	.80**	-.29**	-.58**	1					
5. Anxiety/Introversion	18.94	8.59	.39**	-.47**	-.52**	.40**	1				
6. School liking	13.88	1.79	-.50**	.38**	.51**	-.37**	-.54**	1			
7. Classroom participation	21.24	3.39	-.74**	.45**	.71**	-.55**	-.32**	.56**	1		
8. School avoidance	13.81	1.92	-.39**	-.16**	.32**	-.29**	-.45**	.75**	.33**	1	
9. Self-directiveness	17.55	2.96	-.45**	.54**	.69**	-.31**	-.59**	.56**	.62**	.40**	1

** p < .001, * p < .05

Pearson's correlations were calculated for all study variables (see Table 1). Table 1 shows that there was a significant negative relationship between the teacher-child relationships scale conflict sub-dimension and the social competence ($r = -.68$), school liking ($r = -.50$), classroom participation ($r = -.74$), school avoidance ($r = -.39$), and self-directiveness ($r = -.45$, $p < .001$) scores. The significantly positive relationship between teacher-child relationships scale conflict sub-dimension and anger-aggression ($r = .80$) and anxiety/introversion ($r = .39$) scores. On the other hand, there was a significantly positive correlation between the teacher-child relationships scale closeness sub-dimension and social competence ($r = .66$), school liking ($r = .38$), classroom participation ($r = .45$), and self-directiveness ($r = .54$), scores. In contrast, there was a statistically significant negative correlation between the teacher-child relationships scale closeness sub-dimension and anger/aggression ($r = -.29$), anxiety/introversion ($r = -.47$), and school avoidance ($r = -.16$) scores.

Tablo 2.

The result of the simple linear regression analysis regarding the predictive effect of the teacher-child relationships scale conflict sub-dimension children on their levels school adjustment and social competence.

	R	R ²	F	B	β	t	p
Social competence	.679	.461	353.551	-.382	-.679	-18.803	.00
Anger-aggression	.802	.642	744.965	.537	.802	27.294	.00*
Anxiety/Introversion	.389	.149	73.584	.295	.389	8.578	.00*
School liking	.501	.249	138.875	-1.817	-.501	-11.772	.00
Classroom participation	.736	.541	489.558	-1.415	-.736	-22.126	.00
School avoidance	.388	.149	73.050	-1.312	-.388	-8.547	.00*
Self-directiveness	.445	.196	101.782	-.979	-.445	-10.089	.00

*p < .001, **p < .05.

In Table 2, levels of teacher-child conflict significantly predicted levels of anger/aggression ($R = .802$, $R^2 = .642$, $F = 744.965$), anxiety/introversion ($R = .389$, $R^2 = .149$, $F = 73.584$) and school avoidance ($R = .388$, $R^2 = .149$, $F = 73.050$) levels for children. According to this result, it can be stated that the

teacher-child conflict level account for 64% of anger/aggression, 39% of anxiety/introversion, and 15% of school avoidance levels for children.

Tablo 3.

The result of the simple linear regression analysis regarding the predictive effect of the teacher-child relationships scale closeness sub-dimension children on their levels school adjustment and social competence

	R	R ²	F	B	β	t	p
Social competence	.656	.429	311.554	.277	.656	17.651	.00*
Anger-aggression	.290	.084	37.991	-.146	-.290	-6.164	.00
Anxiety/Introversion	.473	.222	118.963	-.269	-.473	-10.907	.00
School liking	.381	.143	70.181	1.036	.381	8.377	.00*
Classroom participation	.451	.203	105.438	.650	.451	10.268	.00*
School avoidance	.158	.023	10.574	.400	.158	3.252	.00
Self-directiveness	.540	.290	169.806	.891	.540	13.031	.00*

* $p < .001$, ** $p < .05$.

Table 3 shows that teacher-child closeness levels had a predictive effect on social competence ($R=.656$, $R^2 = .429$, $F = 311.554$), school liking ($R = .381$, $R^2 = .143$, $F = 70.181$), classroom participation ($R = .451$, $R^2 = .203$, $F = 105.438$), and self-directiveness ($R = .540$, $R^2 = .290$, $F = 169.806$) levels for children. According to the result, teacher-child closeness levels predicted 43% of social competence, 14% of school liking, 20% of classroom participation, and 29% of self-directiveness levels for children.

Discussion

As a result of the study, it was found that there was a significant relationship between both the conflict and closeness sub-dimensions of the teacher-child relationship and the variables of social competence, anger, anxiety/introversion, classroom participation, school avoidance, self-directiveness, and school liking in children.

As a result of the research, it was found that there was a significant negative relationship between the conflict sub-dimension of the teacher-child relationship scale and social competence, school liking, classroom participation, school avoidance, and self-directiveness. According to this result, as young children are in conflict with their teachers, the level of decreased social competence, school liking, classroom participation, school avoidance, and self-directiveness. A significant positive relationship was determined between the conflict sub-dimension and the anger-aggression, anxiety/introversion. As the teacher-child relationships scale conflict scores increase, the anger-aggression and anxiety/introversion scores increase. On the other hand, it was determined that there was a significant positive relationship between the closeness sub-dimension of the teacher-child relationship and social competence, school liking, classroom participation, and self-directiveness, and a significant negative relationship between, anger-aggression, anxiety/introversion, and school avoidance. The level of social competence, school liking, classroom participation, and self-directiveness together with an increase in the level of teacher-child relationship closeness increases. The level of the teacher-child relationships scales closeness sub-dimension decreases together with an increase in the level of anger/aggression, anxiety/introversion, and school avoidance scores. These results show that children's school adjustment levels and social development are affected by whether the teacher-child relationship is conflictual or close.

The results showed that the conflict sub-dimension of the teacher-child relationship scale significantly predicted the anger/aggression, anxiety/introversion, and school avoidance variables. The results of the study are consistent with existing evidence that problematic behavior in the classroom is one of the strongest predictors of the quality of children's relationships with their teachers (Buyse et al., 2008; Hu et al., 2021). Doumen et al. (2008) found bidirectional relationships between children's aggressive

behavior and teacher-child conflict in preschool. Specifically, children who exhibited high levels of aggressive behavior at the beginning of preschool had more conflict with their teachers after 3 months, leading to even more aggressive behavior at the end of the school year. Similarly, Roorda et al. (2014) reported that both children's externalizing and internalizing problems positively predicted their potential conflict levels in their relationships with teachers, and that teacher-child conflict also predicted children's behavior problems. However, Zatto and Hoglund (2019) found that children with more externalizing problems experienced more conflict in their relationships with their teachers. Zhang and Nurmi (2012) examined the relationship between teacher-child relationships and the social competence of Chinese preschool children and found that teacher-child closeness positively predicted teacher-rated child social competence and teacher-child conflict negatively predicted child social competence. On the other hand, Glüer and Gregoriadis (2017) found that the teacher-child closeness dimension positively influenced social behaviour, while the conflict dimension was associated with externalising behaviour problems. Saral and Acar (2021) found in their study that close teacher-child relationships were positively associated with children's social competence and teacher-child conflict was negatively associated with preschool children's social competence.

As a result of the research, it is understood that the closeness sub-dimension of the teacher-child relationship scale significantly predicts the levels of social competence, school liking, classroom participation, and self-directiveness variables. When children have a warm, close and sincere relationship with their teachers, they will be more positive about liking school and developing positive perceptions about school, and they will feel better at school. On the contrary, children may not want to go to school and may not want to actively participate in the educational process as long as conflict-based, negative relationships develop between teachers and children and closeness is not ensured. A warm and close teacher-child relationship also means that children exhibit fewer behavioral problems and have closer relationships with their peers (Reimers, 2021). On the other hand, as a result of the study conducted by Longobardi et al. (2016), it was determined that the teacher-child relationship was a supportive factor in children's school adjustment. Birch and Ladd (1997) found a negative relationship between a conflicted teacher-child relationship and liking school, while a close teacher-child relationship had a positive relationship with liking school and academic achievement. This supports the findings of the current study on the role of conflict and closeness in school adjustment.

Limitations and Suggestions

This study, which investigates preschool children's relationships with their teachers, school adjustment, and social competencies, is limited to the observations of preschool teachers. Therefore, the findings reflect the subjective views of the teachers. Future studies can try to include other sources such as children's perspectives and observational data on teacher-child relationships. In this respect, it is important to conduct research that examines children's school adjustment and social competencies with objective tests. In addition, quantitative studies with larger samples across Türkiye may provide a larger picture of the effects of the teacher-child relationships, school adjustment, and social competencies in preschool children in Türkiye. Researchers can use more representative and larger samples in future studies to increase the generalisability of the findings. In addition, longitudinal studies will make important contributions to the literature in terms of assessing whether or not this effect is permanent. This study did not take into account variables such as teachers' personality characteristics and children's temperament that may affect teacher-child relationship, children's school adjustment and social competence. In future research, other important aspects such as bonding, teacher and child characteristics can be included.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

Author Contributions: First Author: Conceptualizing, methodology and validation, data analysis and interpretation of data, and writing-review, supervision, and editing.

Second Author: Data collecting, and writing-review.

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A Study on the Gatekeeping Behaviors of Mothers of Preschool Children

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Abstract

This descriptive study was conducted with quantitative research methods to examine the gatekeeping behaviors of mothers of preschool children. The study group in this research consisted of 332 mothers with children aged 36-72 months, who attended preschool education in a primary school or an independent kindergarten in the central districts of Etimesgut, Mamak, Gölbaşı and Polatlı in Ankara and who volunteered to participate in the study. The "General Information Form", which included questions to determine the general characteristics of the participants and children, was used as a data collection tool in the study, and the "Maternal Gatekeeping Scale" was used to determine the interaction behaviors of mothers with their children and spouses. After permission was obtained from the school administration, the mothers with children aged 36-72 months were contacted through teachers. To test whether there was a significant difference in the scales and sub-dimensions in which the parametric test assumptions were made according to age, employment, child's age and child's gender, the t-test was used in independent groups; the One-Way ANOVA test was used to determine whether there was a significant difference according to education and duration of marriage. As a result of the study, it was determined that the mother's age variable made a significant difference in overly attached motherhood, traditional motherhood; education in overly attached motherhood and the total score; employment in modern motherhood, overly attached motherhood; the duration of marriage in twice as much responsibility in motherhood, traditional motherhood, indirect motherhood and the total score; the age of the child in indirect motherhood.

Keywords: Preschool, maternal gatekeeping, mother-child contact, parental contact

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Introduction

The contribution of parents to child development and early childhood education is being increasingly emphasized every day. Mothers are regarded as the main source in child development both in the family and society (Kiliç ve Aral, 2015). Mothers typically offer emotional nurturing and support, fostering strong family bonds and ensuring the well-being of family members. Many mothers undertake the primary role in caregiving, managing household tasks and caring for children, which helps maintain family stability. In studies conducted on children, the importance of the mother is generally emphasized, while the father's involvement is generally ignored (Akyıldırım, 2023; Kuzucu, 2011; Üstündağ, 2023; Yogman and Garfield, 2016). With developing technology, education, politics, science and industry, over the years, people have realised the fact that the father is as important as the mother in a child development (McBride and Mills, 1993). Traditional roles, widely accepted in the past, where the father was primarily responsible for providing financial support, and the mother had a more passive role with housework and child care, have changed over time. The traditional roles of mothers as providing care, nutrition, education and meeting the physical needs of children are gradually decreasing, and more fatherly involvement is necessary due to the changing conditions (Tezel Şahin, Akıncı Coşgun and Aydın Kılıç, 2017).

It has also been observed that active involvement of fathers in childcare not only improves father-child attachment, which benefits child development, but also positively impacts the relationship in the whole family. (Yogman & Garfield, 2016). Flouri (2016) revealed that a father figure has been positively related to the child's academic, mental, social and emotional development, while negatively associated with aggression and low academic achievement. It has also been found that there is a negative association between the major public health issues, such as obesity and Type-2 diabetes, and father-involved child development (Sharp and Lawlor, 2019). However, parents who have internalized the traditional parental roles imposed on by society display some conservative behaviors in order to keep these roles and try to prevent their spouse from taking away their roles (Allen and Hawkins, 1999). Protecting the adopted parental roles and not allowing the other spouse to take up their role is called parental gatekeeping. On the other hand, modern parents share responsibilities related to the household and children and exhibit behaviors that encourage each other's active participation (Fagan & Barnett, 2003). Although a father's participation in a child's life is important in such a manner, some mothers adopt a protective attitude from the moment the child is born and do not allow their spouses to get close to the child, touch or care for them, and although they seem to allow it, anxiety and uneasiness might show up (Dönmez, 2019). In the literature, the refusal of mothers to allow fathers to interfere in child-related matters and the development of critical and negative attitudes towards fathers who want to participate in childcare is called "maternal gatekeeping" (Cannon, Schoppe-Sullivan, Mangelsdorf, Brown, and Sokolowski, 2008). In traditional families, mothers, in particular, may display such behaviors that alienate their spouses from these areas because they regard themselves as more competent in domestic responsibilities and childcaring and may perceive these as maternal duties. Overly attached mothers, besides, may tend to exclude fathers because they believe that there is a natural bond between the mother and the child, and that fathers' involvement damage this bond. Doubly burdened mothers take on excessive responsibility because their spouses do not play any role in child care and education, or in child development, and they take on too much of a burden in order to compensate for the lack of a fatherly role. Through their behaviours, indirect mothers, on the other hand, convey the message; "I am such a perfect mother and wife that my husband does not need to take responsibility in this regard" (Dönmez, 2019). Studies have shown that the involvement of fathers has increased (Arslan, 2022; Deretarla Gül, 2017; Flouri, 2016; Özyürek et al., 2018; Kuzucu, 2011; Semiz and Ören, 2024; Uludağlı, 2017; Yogman et al, 2016). One of the important factors in fathers' involvement in their children's lives is the extent to which the mother approaches the father's participation positively, as well as the cultural background (Deretarla Gül, 2017).

In a developing and changing world, it is important for mothers to allow and support fathers to be active in childcare and development. Although studies on paternal involvement could be found as a result of the literature review (Arslan, 2022; Kuzucu, 2011; Deretarla, 2017; Semiz and Ören, 2024; Tezel Şahin, Akıncı Coşgun and Aydan Kılıç, 2017; Uludağlı, 2017), a limited number of studies were found in Türkiye on maternal gatekeeping behavior in childcare (Başegmez, 2023; İnce, 2022; Kırac, 2023). Nevertheless, it is a known fact that awareness of the father's importance and his role in the care and

development of children is increasing every day. For this reason, the study aims to fill a significant gap in the existing literature. With this motivation, this study was conducted to examine the gatekeeping behaviors of mothers of 36-72 month old children in preschool.

Method

Research Model

This descriptive study was conducted with quantitative research methods to examine the gatekeeping behaviors of mothers of preschool children. Descriptive research serves the purpose of describing the characteristics of individuals, groups or physical environments as fully and carefully as possible (Büyüköztürk et al., 2018).

Study Group

The study group in this research consists of 332 mothers with children aged 36-72 months who attended preschool education in a primary school or an independent kindergarten in the central districts of Etimesgut, Mamak, Gölbaşı and Polatlı in Ankara and who volunteered to participate in the study. The distribution of the demographic characteristics of mothers is shown in Table 1.

Table 1.

Distribution of the demographic characteristics of mothers

		f	%
Age	30 and younger	134	40.40
	31 and older	198	59.60
Education	Primary school	27	8.13
	Middle school	24	7.23
	High school	136	40.96
	Associate degree	64	19.28
	Bachelor's Degree	81	24.40
Employment	Employed	93	28.01
	Unemployed	239	71.99
Duration of marriage	1-5	47	14.16
	6-10	188	56.63
	11-15	57	17.17
	16 and longer	40	12.05
Age of the child	3-4	163	49.10
	5-6	169	50.90
Gender of the child	Girl	162	48.80
	Boy	170	51.20

When Table 1 is examined, it can be observed that 59.60% of the mothers are 31 and older, 40.96% are high school graduates, 71.99% are unemployed, and 56.63% have been married for 6-10 years. A rate of 49.10% of the mothers have children aged 3-4, 50.90% have children aged 5-6, 48.80% have daughters and 51.20% have sons.

Data Collection Tools

The "General Information Form", which included questions to determine the general characteristics of the mothers and children, was used as a data collection tool in the study, and the "Maternal Gatekeeping Scale" developed by Dönmez (2019) was used to determine the interaction behaviors of mothers of preschool children with their children and spouses.

General Information Form

The General Information Form created by the researchers includes questions to determine the mothers' age, education level, employment, marriage duration, and the gender and the age of their children.

Maternal gatekeeping scale

The Maternal Gatekeeping Scale was developed by Dönmez (2019) to determine the interaction behaviors of mothers of preschool children aged 36-72 months with their children and spouses. The scale explains 41.31% of the total variance and shows a 5-factor structure. The scale consists of 5 subdimensions consisting of modern motherhood, twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood and indirect motherhood. The 5-point Likert scale consists

of a total of 57 items (1 "Never", 2 "Rarely", 3 "Sometimes", 4 "Usually", 5 "Always"). The maximum score that can be obtained from the modern motherhood subdimension is 85, whereas the minimum score is 17; the maximum score that can be obtained from the twice as much responsibility in motherhood subdimension is 65, whereas the minimum score is 13; the maximum score that can be obtained from the overly attached motherhood subdimension is 70, whereas the minimum score is 14; the maximum score that can be obtained from the traditional motherhood subdimension is 25, whereas the minimum score is 5; the maximum score that can be obtained from the indirect motherhood subdimension is 40, whereas the minimum score is 8; the maximum score that can be obtained from maternal gatekeeping is 285 and the minimum score is 57. The modern motherhood subdimension, unlike other subdimensions, includes opportunistic mothering behaviors. Therefore, the scores in this subdimension should be reversed and added to the total score when calculating the total score of "Maternal Gatekeeping". In the scale development study, the Cronbach's Alpha values calculated for the subdimensions and total score of the scale were 0.89 for the Modern Motherhood Subdimension, 0.87 for the Twice as Much Responsibility in Motherhood Subdimension, 0.85 for the Overly Attached Motherhood Subdimension, 0.71 for the Traditional Motherhood Subdimension, 0.63 for the Indirect Motherhood Subdimension and 0.90 for the total score of the scale (Dönmez, 2019).

The Cronbach's Alpha values for the maternal gatekeeping scale and its subdimensions in this study were calculated to be 0.92 for the modern motherhood subdimension, 0.91 for the twice as much responsibility in motherhood subdimension, 0.76 for the overly attached motherhood subdimension, 0.77 for the traditional motherhood subdimension, 0.63 for the indirect motherhood subdimension and the total score of the scale was found to be 0.92. It can be concluded that these values are similar to the Cronbach Alpha values calculated in the development study by Dönmez (2019).

Data Collection

The permission to use the scale employed in the study has been obtained from the author herself. Afterwards, ethical permission was obtained from the Ethics Commission of Gazi University dated 21.01.2021 and numbered E.10658. Necessary permissions have been obtained from the Ministry of National Education, and appointments were made with the school administrations where data would be collected. During the interview, the ethics committee permission was shown to the school administration and the purpose of the study was explained. After the permission was obtained from the school administration, mothers with children aged 36-72 months were contacted through the teachers. The data collection tool, which was drafted online in "Google Forms", was sent to the participants via WhatsApp due to pandemic conditions. On the first page of the data collection tool, participants were informed about the scope of the study and the informed consent form, which included that participation in the study was completely voluntary and that participants had the right not to participate in the study or to withdraw at any time after participating in the study.

Data Analysis

Data analysis was carried out with the SPSS program and a confidence level of 95% was maintained. Extreme values were detected in the data by taking the z-scores of the data. The 12 participants showing these extreme values and 11 participants who did not answer some of the questions were removed from the data set. Data analysis was carried out with the data of 332 participants. In the analysis of the data, the Cronbach Alpha internal consistency coefficients were calculated to determine the reliability of the scale and its subdimensions. Mean, standard deviation (ss), median, minimum and maximum values were used for descriptive analyses.

Since the modern motherhood subdimension of the scale includes opportunistic mothering behaviors unlike other subdimensions, the scores in this subdimension were reversed and added to the total score when calculating the total score of "Maternal Gatekeeping".

Before determining the total score of the Maternal Gatekeeping Scale and the subdimension scores of modern motherhood, twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood, indirect motherhood according to the variables of age, education, employment, marriage duration, child's age, and child's gender, Levene statistics were used to test the homogeneity of the data set and skewness and kurtosis coefficients were used to test the normality assumption. It has been observed that kurtosis and skewness values meet the normality assumption between +1 and -1

(Can, 2013; Çokluk, Şekercioğlu, and Büyükoztürk, 2010; Morgan, Leech, Gloeckner, and Barrett, 2004).

To test whether there was a significant difference in the scale and sub-dimensions in which the parametric test assumptions were made according to age, employment, the child's age and child's gender, the t-test was used in independent groups; the One-Way ANOVA test was used to determine whether there was a significant difference according to education and duration of marriage. In order to decide which post-hoc multiple comparison technique would be used to determine the groups from which differences arose after ANOVA, the hypothesis of whether the variances of the group distributions were homogeneous or not was tested with the Levene test, according to which it was determined that the variances were homogeneous ($p>0.05$). Therefore, the widely used Scheffé method of multiple comparisons was preferred in homogeneous variances. The reason why the Scheffé test is preferred is that the test is sensitive to Alpha type errors.

Findings

In this section, the total score of the Maternal Gatekeeping Scale and modern motherhood, twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood, indirect motherhood subdimension scores and the tables and explanations for comparing these scores according to age, education, employment, marriage duration, child's age and child's gender are included.

Table 2.

Descriptive Statistics Regarding the Maternal Gatekeeping Scale and Subdimensions

	$\bar{X}$	ss	Median	Minimum	Maximum
Modern Motherhood	68.72	12.58	72.00	17.00	85.00
Twice as much responsibility in motherhood	24.52	10.30	21.00	13.00	65.00
Overly Attached Motherhood	51.49	7.77	52.00	27.00	70.00
Traditional Motherhood	13.75	4.66	14.00	5.00	25.00
Indirect Motherhood	14.11	3.97	13.00	8.00	29.00
Total Score Maternal Gatekeeping	137.15	27.12	132.00	79.00	233.00

When Table 2 is examined, it can be observed that the modern motherhood subdimension mean score is 68.72 ($ss=12.58$), the twice as much responsibility in motherhood subdimension mean score is 24.52 ($ss=10.30$), the overly attached motherhood subdimension mean score is 51.49 ($ss=7.77$), the traditional motherhood subdimension mean score is 13.75 ($ss=4.66$), the traditional motherhood subdimension mean score is 13.75 ($ss=4.66$), the indirect motherhood subdimension mean score is 14.11 ($ss=3.97$), and the maternal gatekeeping (total score) mean score is 137.15 ($ss=27.12$). Accordingly, it can be suggested that the modern motherhood and overly attached motherhood of participants are closer to the maximum value, whereas the twice as much responsibility in motherhood and indirect motherhood are closer to the minimum value. It can be said that the traditional motherhood and maternal gatekeeping behaviors of mothers are somewhere between the minimum and maximum values.

Table 3.

Independent Group t-test Results Conducted to Determine whether Maternal Gatekeeping Scale and Subdimension Scores Differ According to Age Variables

	Age of mother	n	$\bar{X}$	ss	t	sd	p
Modern Motherhood	30 and younger	134	69.50	12.76	0,933	330	0,351
	31 and older	198	68.19	12.46			
Twice as much responsibility in motherhood	30 and younger	134	23.25	9.41	-1,841	330	0,066
	31 and older	198	25.37	10.81			
Overly Attached Motherhood	30 and younger	134	52.57	6.67	2,093	330	0,037
	31 and older	198	50.76	8.37			
Traditional Motherhood	30 and younger	134	12.90	4.38	-2,764	330	0,006
	31 and older	198	14.33	4.76			
Indirect Motherhood	30 and younger	134	14.10	4.10	-0,015	330	0,988
	31 and older	198	14.11	3.90			
Total Score Maternal Gatekeeping	30 and younger	134	135.33	24.66	-1,006	330	0,315
	31 and older	198	138.38	28.66			

When Table 3 is examined, it can be observed that there is a significant difference in the average scores of mothers in the maternal gatekeeping scale, the subdimensions of overly attached motherhood ($t(330)=2.093$) and traditional motherhood ($t(330)=-2.764$) according to age ($p<0.05$). In terms of the scores obtained from the overly attached motherhood subdimension of the scale, it can be observed that the average score of mothers aged 30 and younger ($\bar{x}=52.57$, $ss=6.67$) is higher than the average score of mothers aged 31 and older ($\bar{x}=50.76$, $ss=8.37$). In terms of the scores obtained from the traditional motherhood subdimension, it can be observed that the average score of mothers aged 31 and over ($\bar{x}=14.33$, $ss=4.76$) is higher than the average score of mothers aged 30 and younger ($\bar{x}=12.90$, $ss=4.38$). In addition, there was no significant difference between the subdimension score averages of modern motherhood, twice as much responsibility in motherhood, indirect motherhood scores and total score of maternal gatekeeping ($p \geq 0.05$) according to the age variable.

Table 4.

Results of One-Way Analysis of Variance (ANOVA) Conducted to Determine Whether the Maternal Gatekeeping Scale and Sub-Dimension Scores Differ According to the Education Variables.

Gatekeeping Scale and 500 Dimension Scores Differ According to the Education Variables.											
		n	$\bar{X}$	ss	Var. c.	Sum of squares	df	Squares average	F	p	
Modern Motherhood	Primary school	27	64.63	14.16	Intergr.	644.92	4	161.23	1,019	0,397	
	Middle school	24	68.96	13.00	Intragr.	51720.47	327	158.17			
	High school	136	69.07	11.10	Total	52365.39	331				
	Associate degree	64	67.95	13.97	Significant difference : -						
	Bachelor's degree	81	70.02	13.08							
	Total	332	68.72	12.58							
Twice as much responsibility in motherhood	Primary school	27	27.96	10.33	Intergr.	871.97	4	217.99	2,080	0,083	
	Middle school	24	28.17	12.62	Intragr.	34276.95	327	104.82			
	High school	136	24.06	9.29	Total	35148.92	331				
	Associate degree	64	24.66	10.79	Significant difference : -						
	Bachelor's degree	81	22.94	10.52							
	Total	332	24.52	10.30							
Overly Attached Motherhood	Primary school	27	55.19	7.40	Intergr.	2445.07	4	611.27	11,404	0.000	
	Middle school	24	57.42	7.19	Intragr.	17527.88	327	53.60			
	High school	136	52.24	6.95	Total	19972.95	331				
	Associate degree	64	50.84	6.72	Significant difference : Bachelor> Primary school, Middle school, High school						
	Bachelor's degree	81	47.75	8.33							
	Total	332	51.49	7.77							
Traditional Motherhood	Primary school	27	14.44	5.23	Intergr.	116.31	4	29.08	1,347	0,252	
	Middle school	24	15.08	4.61	Intragr.	7057.44	327	21.58			
	High school	136	13.95	4.56	Total	7173.75	331				
	Associate degree	64	13.58	4.90	Significant difference : -						
	Bachelor's degree	81	12.94	4.38							
	Total	332	13.75	4.66							
Indirect Motherhood	Primary school	27	15.70	3.39	Intergr.	147.54	4	36.89	2,375	0,052	
	Middle school	24	15.42	3.74	Intragr.	5078.55	327	15.53			
	High school	136	13.90	3.91	Total	5226.10	331				
	Associate degree	64	14.17	3.82	Significant difference : -						
	Bachelor's degree	81	13.48	4.28							
	Total	332	14.11	3.97							
Total Score Maternal Gatekeeping	Primary school	27	150.67	28.62	Intergr.	13643.2	4	3410.82	4,853	0.001	
	Middle school	24	149.13	26.57	Intragr.	229816.4	327	702.80			
	High school	136	137.08	24.20	Total	243459.7	331				
	Associate degree	64	137.30	28.56	Significant difference : Bachelor> Primary school, Middle school						
	Bachelor's degree	81	129.09	27.80							
	Total	332	137.15	27.12							

When Table 4 is examined, it can be observed that the average scores of the overly attached motherhood subdimension ($F(4, 327)=11.404$) and total score ($F(4, 327)=4.853$) of the maternal gatekeeping scale show a significant difference in terms of education ($p<0.05$). After the Scheffé test was conducted to determine between which groups differences were present, it was established that the overly attached motherhood scores of mothers with a bachelor's degree ($\bar{x}=47.75$, $ss=8.33$) were significantly lower than that of primary school ($\bar{x}=55.19$, $ss=7.40$), middle school ($\bar{x}=57.42$, $ss=7.19$) and high school ($\bar{x}=52.24$, $ss=6.95$) graduates. It was also established that the total maternal gatekeeping scores of mothers with bachelor's degrees ($\bar{x}=129.09$, $ss=27.80$) were significantly lower than those of primary school ($\bar{x}=150.67$, $ss=28.62$) and middle school graduates ($\bar{x}=149.13$, $ss=26.57$). In addition, the education variable did not result in a significant difference on the average scores of the modern motherhood, twice

as much responsibility in motherhood, traditional motherhood and indirect motherhood subdimensions ($p \geq 0.05$).

Table 5.

Independent Group t-test Results Conducted to Determine whether Maternal Gatekeeping Scale and Subdimension Scores Differ According to Employment Variables

		n	$\bar{x}$	ss	t	sd	p
Modern Motherhood	Employed	93	67.92	13.77	-0.715	330	0.475
	Unemployed	239	69.03	12.10			
Twice as much responsibility in motherhood	Employed	93	24.33	10.28	-0.200	330	0.841
	Unemployed	239	24.59	10.33			
Overly Attached Motherhood	Employed	93	47.87	7.76	-5.523	330	0.000
	Unemployed	239	52.90	7.32			
Traditional Motherhood	Employed	93	12.85	4.85	-2.219	330	0.027
	Unemployed	239	14.10	4.54			
Indirect Motherhood	Employed	93	14.00	4.48	-0.310	330	0.757
	Unemployed	239	14.15	3.77			
Total Score Maternal Gatekeeping	Employed	93	133.13	27.32	-1.689	330	0.092
	Unemployed	239	138.71	26.94			

When Table 5 is examined, it can be observed that there is a significant difference in the average scores of the overly attached motherhood ($t(330)=-5.523$) and traditional motherhood ($t(330)=-2.219$) subdimensions of the maternal gatekeeping scale, according to employment ($p < 0.05$). In terms of the scores obtained from the overly attached motherhood and traditional motherhood subdimensions, the average score of unemployed mothers (overly attached motherhood: $\bar{x}=52.90$, $ss=7.32$; traditional motherhood: $\bar{x}=14.10$, $ss=4.54$) seems to be higher than that of employed mothers (overly attached motherhood: $\bar{x}=47.87$, $ss=7.76$; traditional motherhood: $\bar{x}=12.85$, $ss=4.85$). In addition, there was no significant difference between the subdimension score averages of modern motherhood, twice as much responsibility in motherhood, indirect motherhood scores and total score of maternal gatekeeping ($p \geq 0.05$) according to the employment variable.

Table 6.

Results of One-Way Analysis of Variance (ANOVA) Conducted to Determine Whether the Maternal Gatekeeping Scale and Sub-Dimension Scores Differ According to Marriage Duration.

		n	$\bar{x}$	ss	Var. c.	Sum of squares	df	Squares average	F	p
Modern Motherhood	1-5	47	66.28	12.80	Intergr.	3974.55	3	1324.85	8980	0.000
	6-10	188	71.12	11.89	Intragr.	48390.83	328	147.53		
	11-15	57	68.46	10.25	Total	52365.39	331			
	16 and longer	40	60.65	14.80	Significant difference: 16 and longer<1-5, 6-10 and 11-15					
	Total	332	68.72	12.58						
Twice as much responsibility in motherhood	1-5	47	23.19	7.59	Intergr.	1825.19	3	608.40	5988	0.001
	6-10	188	23.35	10.33	Intragr.	33323.74	328	101.60		
	11-15	57	25.23	9.84	Total	35148.92	331			
	16 and longer	40	30.55	11.64	Significant difference: 16 and longer> 1- 5 and 6-10					
	Total	332	24.52	10.30						
Overly Attached Motherhood	1-5	47	50.64	7.55	Intergr.	100.25	3	33.42	0.552	0.647
	6-10	188	51.95	7.63	Intragr.	19872.70	328	60.59		
	11-15	57	50.86	8.18	Total	19972.95	331			
	16 and longer	40	51.20	8.18	Significant difference: -					
	Total	332	51.49	7.77						
Traditional Motherhood	1-5	47	13.53	4.40	Intergr.	282.96	3	94.32	4490	0.004
	6-10	188	13.32	4.51	Intragr.	6890.79	328	21.01		
	11-15	57	13.63	4.85	Total	7173.75	331			
	16 and longer	40	16.23	4.74	Significant difference: 16 and longer> 1- 5 and 6-10					
	Total	332	13.75	4.66						
Indirect Motherhood	1-5	47	15.34	4.94	Intergr.	211.21	3	70.40	4605	0.004
	6-10	188	13.44	3.41	Intragr.	5014.88	328	15.29		
	11-15	57	14.60	4.51	Total	5226.10	331			
	16 and longer	40	15.13	3.86	Significant difference: 1- 5> 6- 10					
	Total	332	14.11	3.97						
Total Score Maternal Gatekeeping	1-5	47	138.43	22.85	Intergr.	15423.40	3	5141.13	7395	0.000
	6-10	188	132.93	26.14	Intragr.	228036.37	328	695.23		
	11-15	57	137.86	27.65	Total	243459.77	331			
	16 and longer	40	154.45	29.27	Significant difference: 16 and> 1-5, 6-10 and 11-15					
	Total	332	137.15	27.12						

When Table 6 is examined, it can be observed that the modern motherhood ($F(3,328)= 8.980$), doubly burdened motherhood ($F(3,328)= 5.988$), traditional motherhood ($F(3,328)= 4.490$), indirect motherhood subdimension scores of the maternal gatekeeping scale and maternal gatekeeping total score ($F(3, 328)= 7.395$) averages show a significant difference in terms of marriage duration ($p<0.05$). After the Scheffé test was conducted to determine between which groups differences were present, it was established that the modern motherhood subdimension scores of participants who had been married for 16 years or longer ($\bar{x}=60.65$, $ss=14.80$) were significantly lower than those of mothers who had been married for 1-5 ($\bar{x}=66.28$, $ss=12.80$), 6-10 ($\bar{x}=71.12$, $ss=11.89$) and 11-15 ($\bar{x}=68.46$, $ss=10.25$) years. It was found that mothers who had been married for sixteen years or longer had significantly higher twice as much responsibility in motherhood ($\bar{x}=30.55$, $ss=11.64$) and traditional motherhood ($\bar{x}=16.23$, $ss=4.74$) subdimension scores compared to mothers who had been married for 1-5 (twice as much responsibility in motherhood, $\bar{x}=23.19$, $ss=7.59$; traditional motherhood, $\bar{x}=13.53$, $ss=4.40$ and 6-10 (twice as much responsibility in motherhood, $\bar{x}=23.19$, $ss=7.59$; traditional motherhood, $\bar{x}=13.32$, $ss=4.51$) years. It was determined that the indirect motherhood subdimension scores of mothers who were married for 1-5 years ($\bar{x}=15.34$, $ss=4.94$) were significantly higher than those of mothers who were married for 6-10 years ($\bar{x}=13.44$, $ss=3.41$). Ultimately, it was established that the total maternal gatekeeping scores of mothers who had been married for 16 years or longer ($\bar{x}=154.45$, $ss=29.27$) were significantly higher than those of mothers who had been married for 1-5 ($\bar{x}=138.43$, $ss=22.85$), 6-10 ($\bar{x}=132.93$, $ss=26.14$) and 11-15 ($\bar{x}=137.86$, $ss=27.65$) years. In addition, the marriage duration variable did not result in a significant difference in the overly attached motherhood subdimension score averages ($p\geq 0.05$).

Table 7.

Independent Group t-test Results Conducted to Determine whether Maternal Gatekeeping Scale and Subdimension Scores Differ According to Child Age Variables

		n	$\bar{x}$	ss	t	sd	p
Modern Motherhood	3-4	163	68.24	12.34	-0.679	330	0.498
	5-6	169	69.18	12.82			
Twice as much responsibility in motherhood	3-4	163	24.66	9.90	0.256	330	0.798
	5-6	169	24.37	10.71			
Overly Attached Motherhood	3-4	163	50.94	7.48	-1.267	330	0.206
	5-6	169	52.02	8.03			
Traditional Motherhood	3-4	163	13.93	4.53	0.689	330	0.491
	5-6	169	13.58	4.78			
Indirect Motherhood	3-4	163	14.59	4.44	2.176	330	0.030
	5-6	169	13.64	3.42			
Total Score Maternal Gatekeeping	3-4	163	137.88	26.68	0.485	330	0.628
	5-6	169	136.44	27.60			

When Table 7 is examined, it can be observed that there is a significant difference in the average scores of the indirect motherhood ($t(330)=2.176$) subdimension of the maternal gatekeeping scale, according to the age of the child ($p<0.05$). In terms of the scores obtained from the indirect motherhood subdimension, it can be observed that the average score of mothers with children aged three and four ($\bar{x}=14.59$, $ss=4.44$) is higher than the average score of mothers with children aged five and six ($\bar{x}=13.64$, $ss=3.42$). In addition, there was no significant difference between the subdimension score averages of twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood scores and total score averages of maternal gatekeeping ($p\geq 0.05$) according to the child age variable.

According to table 8, there is no significant difference between the subdimension score averages of twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood, indirect motherhood and total score averages of maternal gatekeeping ($p\geq 0.05$) according to the child gender variable

Table 8.

Independent Group t-test Results Conducted to Determine whether Maternal Gatekeeping Scale and Subdimension Scores Differ According to Child Gender Variables

		n	X	ss	t	sd	p
Modern Motherhood	Female	162	68.51	11.64	-0.289	330	0.773
	Male	170	68.91	13.44			
Twice as much responsibility in motherhood	Female	162	24.91	10.35	0.687	330	0.492
	Male	170	24.14	10.27			
Overly Attached Motherhood	Female	162	51.58	7.98	0.211	330	0.833
	Male	170	51.40	7.58			
Traditional Motherhood	Female	162	14.01	4.56	0.967	330	0.334
	Male	170	13.51	4.74			
Indirect Motherhood	Female	162	14.35	4.15	1.090	330	0.277
	Male	170	13.88	3.79			
Total Score Maternal Gatekeeping	Female	162	138.34	26.04	0.781	330	0.435
	Male	170	136.01	28.15			

Discussion, Conclusion, and Suggestions

According to the analysis on the maternal gatekeeping scale and its subdimensions, it can be suggested that modern motherhood and overly attached motherhood are closer to the maximum value, whereas twice as much responsibility in motherhood and indirect motherhood are closer to the minimum value. It can be said that the traditional motherhood and maternal gatekeeping behaviors of mothers are somewhere between the minimum and maximum values. According to the results of the study conducted by Altenburger and Schoppe-Sullivan (2021), which supports this finding, the maternal gatekeeping behaviors were found to be at a moderate level. They have stated that the father's personality and the mother's sense of responsibility, extroversion and belief factors may play an important role in the maternal gatekeeping behavior. In the study conducted by Wang, Zhu and Ji (2021), it was stated that one of the factors affecting maternal watchdog behavior is mother-adolescent attachment. Also in this study, it is thought that the quality of mother-child attachment may be effective on overly attached motherhood behavior. The reason why mothers have higher scores in the modern motherhood and overly attached motherhood subdimensions is perhaps that mothers may be more inclined to exhibit modern rather than traditional behavior due to the current age and opportunities, and to give the father also some opportunities and responsibilities in child development and education.

According to the analysis conducted, to determine whether the maternal gatekeeping scale and subdimension scores differ according to the mother's age variable, no significant difference was found between the mother's age and the total maternal gatekeeping score, and the modern motherhood, twice as much responsibility in motherhood, indirect motherhood subdimension scores. However, it was determined that there was a significant difference in favor of mothers aged 30 and younger in the overly attached motherhood subdimension, and in favor of mothers aged 31 and older in the traditional motherhood subdimension. In the study conducted by Kulik and Tsoref (2010), it was established that there was no relationship between maternal gatekeeping behavior and the age of the mother; In the study conducted by Akdan (2021), it was found that as the age of the mother increased, the traditional motherhood score increased as well. In the study conducted by Dönmez (2019), it was found that young mothers showed overly attached motherhood behavior. These findings support the study results. In this study, the reason why the mother's age does not make a significant difference in on the total score of maternal gatekeeping and in modern motherhood, twice as much responsibility in motherhood, and indirect motherhood subdimension scores is thought to be that even though the mothers' ages are different, their awareness of childcare is similar due to the age they live in and their ability to access the opportunities offered. For this reason, it can be thought that the maternal gatekeeping behaviors of mothers of different ages are similar because they provide similar opportunities for their spouses in child development. Nevertheless, the fact that mothers aged thirty and younger showed overly attached behavior more than other age groups, which is one of the maternal gatekeeping behaviors, and may be due to the fact that young mothers are more attached to the child since they have just begun motherhood. The fact that mothers aged thirty-one and older exhibited overly attached behavior more than other age groups, which is one of the maternal gatekeeping behaviors, can be explained by the fact that mothers

were more closely related to a more traditional age in a world that was constantly developing and changing.

According to the results of the analysis conducted to determine whether the maternal gatekeeping scale and its subdimension scores differ according to the mother's education variable, it was determined that the overly attached motherhood behaviors of mothers with a bachelor's degree were significantly lower than those of primary school, secondary school and high school graduates. It was also established that the total maternal gatekeeping scores of mothers with bachelor's degrees were significantly lower than those of primary school and middle school graduates. In addition, the education variable did not result in a significant difference in on the average scores of the modern motherhood, twice as much responsibility in motherhood, traditional motherhood and indirect motherhood subdimensions. When the literature is examined, there are studies (Maslauskaite, 2011; Nakagawa, 2010; Reed, 2009) that support these results. It is thought that as the education level of mothers increases, their ability to access information about childcare increases, and thus, they have knowledge on the responsibilities of their spouses and act in cooperation with them in childcare, and show less excessive attachment behaviors towards the child. However, in the study conducted by Hauser (2015), it was concluded that as the education level of the mother increases, maternal gatekeeping behaviors are exhibited more. It is thought that the reason for such a result in the study conducted by Hauser (2015) is that as the mother's education level increases, she may exhibit maternal gatekeeping behavior due to the fact that she finds herself more educated, knowledgeable and qualified than the father in terms of childcare. In this study, the reason why there is no significant difference between the elements of maternal gatekeeping behavior, such as indirect motherhood, traditional motherhood and twice as much responsibility in motherhood according to the mother's education level suggests that these dimensions of maternal gatekeeping behavior are related to the difference in child development and care and the social structure they are in, rather than the level of education. Bronfenbrenner's ecological systems theory supports this by positing that an individual's development is influenced by a series of interconnected environmental systems.

According to the analysis conducted to determine whether the maternal gatekeeping scale and its subdimension scores differ according to the mother's employment variable, it can be concluded that unemployed mothers exhibit more overly attached motherhood and traditional motherhood behaviors than employed mothers. In addition, there was no significant difference between the subdimension score averages of modern motherhood, twice as much responsibility in motherhood, indirect motherhood scores and the total score of maternal gatekeeping according to the employment variable. In support of this finding, the study conducted by Karabulut and Şendil (2017) found that the mother's employment status did not affect maternal watchdog behavior. In this study, it is revealed that the reason why unemployed mothers showed more overly attached motherhood and traditional motherhood behaviors than employed mothers is that unemployed mothers may exhibit overly attached and traditional motherhood behaviors because they regard observe themselves as the responsible person for childcare in terms of their social roles and may want to glorify the role of motherhood, as a result of not having economic freedom.

According to the results of the analysis conducted to determine whether the maternal gatekeeping scale and its subdimension scores differ according to the variable of marriage duration, it has been found that mothers who have been married for 16 years or longer exhibit fewerless modern motherhood behaviors and more maternal gatekeeping than those who have been married for 1-5, 6-10 and 11-15 years. In addition, it can be said that mothers who have been married for 16 years or longer exhibit twice as much responsibility in motherhood and traditional motherhood than mothers who have been married for 1-5 and 6-10 years. It can be said that mothers who have been married for 1-5 years exhibit more indirect motherhood behaviors than mothers who have been married for 6-10 years. It was determined that mothers with a marriage duration of 16 years or longer exhibited more maternal gatekeeping behaviors than other mothers. In addition, the marriage duration variable did not result in a significant difference in the overly attached motherhood subdimension score averages. As a result, it can be observed that mothers with longer marriage durations exhibit twice as much responsibility in motherhood, traditional motherhood and maternal gatekeeping behaviors than those with shorter marriage duration, but less modern motherhood behaviors.

In the study conducted by Dönmez (2019) on the relationship between the duration of marriage and maternal gatekeeping behaviors in the literature, similar results were found in the modern motherhood subdimension to support these findings. To summarize, this study concluded that those who have been married for a long time display more maternal gatekeeping, twice as much responsibility in motherhood and traditional motherhood behaviors and less modern motherhood than those who have been married for a short time. It is suggested that the reason for this is that mothers who have been married for a longer time are less affected by the cultural changes, such as traditions in society due to an early marriage, and as a result, they may exhibit more traditional and twice as much responsibility in motherhood behavior, considering themselves to be the parent responsible for childcare, and they may exhibit maternal gatekeeping behaviors.

According to the analysis carried out to determine whether the maternal gatekeeping scale and its subdimension scores differ according to the child's age variable, it was concluded that the mothers whose children were three and four years old showed more indirect motherhood behaviors than those whose children were aged five and six. In addition, it was concluded that there was no significant difference between the subdimension score averages of twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood scores and total score averages of maternal gatekeeping according to the child age variable. In the study conducted by Yıldız (2021), these findings are supported by similar results in the dimensions of twice as much responsibility in motherhood, traditional motherhood and maternal gatekeeping. In the study conducted by De Luccie (1995), it is stated that the maternal gatekeeping behaviors exhibited by mothers are related to the age of the child. In this study, it is proposed that the reason why mothers with children aged three and four showed more indirect motherhood behavior than mothers with children aged five and six may be due to the fact that younger children are more reliant upon their mothers and that mothers take on more responsibility and want to show those around them that they have succeeded in the responsibilities they have taken as these experiences are newer for them compared to mothers with more experience and support from the environment seems to be more crucial at this stage.

According to the analysis conducted to determine whether the maternal gatekeeping scale and subdimension scores differ according to the child's gender variable, the child's gender variable does not create a significant difference in the average subdimension scores of modern motherhood, twice as much responsibility in motherhood, overly attached motherhood, traditional motherhood, indirect motherhood subdimension average scores and the total score averages of maternal gatekeeping. There are other studies in the literature showing that the child's gender does not make a significant difference in the total score and subdimensions of maternal gatekeeping behavior (Akdan, 2021; Yıldız, 2021). Ideally, parents would not behave differently according to gender in the care and education of their children in the process of social change and development. Therefore, it can be thought that maternal gatekeeping behaviors do not differ according to the gender of their children.

Rather than the increase in the employment rates of mothers in a changing and developing world, fathers are becoming more and more involved in the care of their children each day, as the role of the father in the child's development has become undeniable. In this situation, some mothers sometimes feel twice as much responsible because they doubt that fathers provide adequate care, especially in the care of children at a young age, therefore, sometimes becoming overly attached, taking up a traditional role, and sometimes exhibiting indirect motherhood through fathers, thereby excluding fathers. Some mothers, on the other hand, exhibit modern motherhood behavior by exhibiting a cooperative attitude with fathers in the care and development of the child.

In this study, which was conducted to examine the maternal gatekeeping behaviors of mothers with children aged 36-72 months, it was concluded that the modern motherhood and overly attached motherhood exhibited by mothers were closer to the maximum value, while twice as much responsibility in motherhood and indirect motherhood were closer to the minimum value, and that traditional motherhood and maternal gatekeeping behaviors fell between the minimum and maximum values. It was concluded that there was a significant difference in favor of mothers aged 30 and younger in the overly attached motherhood subdimension, and in favor of mothers aged 31 and older in the traditional motherhood subdimension. It was determined that the overly committed motherhood behaviors of mothers with bachelor's degrees were significantly lower than those of primary school, secondary school

and high school graduates. It was also established that the total maternal gatekeeping scores of mothers with bachelor's degrees were significantly lower than those of primary school and middle school graduates. It was concluded that unemployed mothers exhibited more overly attached motherhood and traditional motherhood behaviors than employed mothers. It has been determined that mothers who had been married for 16 years or longer exhibited less modern motherhood and more maternal gatekeeping behaviors than those who had been married for 1-5, 6-10 and 11-15 years. It was concluded that the indirect motherhood behaviors of mothers with children aged three and four was significantly higher than those with children aged five and six. It was concluded that the gender of the child variable did not create a significant difference in the total score and subdimension score averages of the maternal gatekeeping scale.

The following suggestions are included in line with the findings obtained in this study, which examines the maternal gatekeeping behaviors of mothers with children aged 36-72 months.

1. This study, conducted with mothers of children aged 36-72 months, can be carried out more comprehensively with a different sample and variable group (such as different age groups, inclusion of fathers and grandparents).
2. Organizing informative trainings for mothers who have been married for a long time, especially to support their spouses in child care and development,
3. By conducting a scale study on maternal gatekeeping behaviors, the paternal gatekeeping behaviors in childcare can be examined.
4. This study was conducted in a quantitative manner. A qualitative study on maternal gatekeeping behaviors can be conducted by face-to-face interviews with both mothers and fathers.
5. Face-to-face or online educational-supportive activities and programs such as seminars, courses, posters, brochures, public service announcements and family participation activities can be carried out for families and other stakeholders responsible for child care and health by educators and institutions on issues, such as gender equality, the role of parents in child care, parental communication skills and parental attitudes.

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Ethics statement: In this study, we declare that the rules stated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" are complied with and that we do not take any of the actions based on "Actions Against Scientific Research and Publication Ethics". At the same time, we declare that there is no conflict of interest between the authors, which all authors contribute to the study, and that all the responsibility belongs to the article authors in case of all ethical violations.

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Unveiling Educators' Insights on Artificial Intelligence in Education: A Qualitative Study of Potential, Expectations, and Challenges¹

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Abstract

This study investigated teachers' opinions on using artificial intelligence (AI) in education. The aim was to gain insight into teachers' expectations, desires, and concerns regarding AI applications that would be used more frequently in education shortly. Teachers were consulted about the purposes for which AI could be used in their lessons and the current level of AI utilization. A qualitative research method was used in the study. Data on the use of AI in education were collected through semi-structured interviews with teachers. The collected data were analyzed using content analysis. According to the findings, teachers believe AIs can be used for language learning, personalized education, and individual student tracking. All teachers participating in the study had a positive view of the use of AI in education. Moreover, most teachers think that AI applications will increase academic success; however, they expect AI to be suitable for the student level, provide feedback for the student, and evaluate the teaching process. Participants, who stated that teachers also have responsibilities in using AI, emphasized that teachers need to improve by receiving training on this subject. The study revealed teachers' concerns about using AI, bringing these reservations to light. In the study's conclusion, suggestions were given, such as the necessity of using AI in education and considering teachers' concerns. It also addressed what needs to be done to promote the widespread use of AI nationwide.

Keywords: Artificial intelligence, education, teaching, teacher perspectives.

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Introduction

Rapid advancements in digital technologies have significantly reshaped contemporary societies, particularly in the context of Industry 4.0 and Society 5.0. These developments have paved the way for artificial intelligence (AI) to play an increasingly central role in various sectors, including education. Within the educational sphere, AI holds promise for personalized learning experiences, automated assessment, and enhanced opportunities for both learners and educators. Despite growing scholarly interest in AI-driven education, there remains a need for deeper investigation into teachers' knowledge and perspectives on AI.

Against this backdrop, the present study explores educators' insights on AI in education. By examining teachers' levels of AI awareness and their views on its applications and potential influence on student success, this research seeks to contribute to the literature on AI's expected role in shaping future educational practices.

The Industrial Revolutions

From Industry 1.0 to Industry 4.0

The eighteenth century witnessed a significant transformation when the Industrial Revolution (often referred to as Industry 1.0) emerged in England and later spread across Europe. Societies began transitioning from agricultural to industrial economies during this era. Subsequent phases—Industry 2.0, Industry 3.0, and Industry 4.0—brought notable technological, environmental, and social changes, typically orchestrated or facilitated by governments (Janicke & Jacob, 2009).

Over the past two centuries, societies have integrated mechanization and computer systems into everyday life. Industry 4.0, formalized and supported in Germany by the twenty-first century, has emphasized digitalization across sectors. The Industrie 4.0 Working Group (2013) defines Industry 4.0 as “a new phase of value creation and management throughout the life cycle of products” (Hermann et al., 2015). This period is characterized by digital technologies becoming indispensable, particularly in healthcare, agriculture, economics, and defense, where they enhance speed, efficiency, and innovation (Öztürk, 2013; Firat & Firat, 2017).

Key Features of Industry 4.0

Industry 4.0 includes significant innovations such as:

- Robots with decision-making and mass-production capabilities
- Information networks that communicate among themselves and with humans
- Cyber-physical systems that enable systems integration
- Cybersecurity systems that protect against cyber-attacks
- Internet of Things (IoT) applications facilitating communication across societal spheres
- Cloud computing systems for software and data management
- Augmented reality that bridges digital and natural environments
- 3D printers for on-demand production (Öztemel, 2018)

Society 5.0

Emergence and Conceptualization

While Industry 4.0 continues to advance in Germany, Japan introduced the concept of Society 5.0. First appearing in a national political discourse (Keidanren, 2016; Harayama, 2017), Society 5.0 was officially named by Prime Minister Shinzo Abe in 2017 (Develi, 2017). This new era envisions leveraging the digital revolution's technological achievements for the broader benefit of humanity (Fukuyama, 2018).

Society 5.0 aims to evolve into a “super-smart society” wherein technology is harnessed to solve social, economic, and environmental challenges. Focusing on “technology for society,” this human-centric approach aspires to integrate digital tools seamlessly into daily life, thereby addressing social problems and fostering overall happiness (Mutluol, 2018). Japan has openly endorsed initiatives to realize a super-smart society across various global forums (Fukoda, 2020, cited in Er et al., 2021).

Applications in Society 5.0

Society 5.0 is anticipated to introduce numerous initiatives, notably:

- Smart cities, where crucial urban functions (e.g., communication, transportation, energy, and water) operate autonomously via computer software
- Smart homes featuring devices (e.g., refrigerators that restock automatically) and systems (e.g., climate control that adjusts proactively)

- Driverless cars, aided by AI, for safer and more efficient transportation
- Wearable technologies offer users greater convenience in health monitoring, communication, and more (Öztürk & Ateş, 2021)

Artificial Intelligence

Definitions and Historical Context

Industry 4.0 and Society 5.0 heavily rely on AI, which is generally defined as machine-based intelligence capable of performing tasks that traditionally require human cognition (URL-1). According to the European Parliament (2016), AI systems evaluate surrounding data to achieve specified goals, demonstrate partial autonomy, and exhibit intelligent behaviors. These systems aim to perform abstract thinking, problem-solving, judgment, and learning from experience (Dülger, 2018).

Although early notions of artificial intelligence can be traced back to antiquity, the modern foundations of AI were laid in the mid-twentieth century. In 1950, Alan Turing introduced the Test, evaluating machines' capacity to emulate human-like thought and conversation. In 1956, John McCarthy's workshop at Dartmouth College marked a pivotal step in formalizing AI research (Mijwel, 2015; Öteş et al., 2018, cited in Kaya, 2021). Since then, AI-related studies and applications—ranging from search engines to autonomous vehicles and unmanned agriculture—have proliferated (Koroğlu, 2017).

Current AI Applications

Contemporary AI implementations span numerous domains:

- Speech recognition, image processing, and natural language processing
- Navigation systems and recommendation algorithms
- Healthcare services (e.g., patient data analytics)
- Retail and e-commerce (e.g., personalized product recommendations)
- Manufacturing (e.g., robotic systems in factories, automated quality control)
- Transportation (e.g., driver assistance technologies, autonomous vehicles)

AI in Education

Potential Benefits

AI offers substantial benefits in educational contexts, notably through personalized learning. By allowing each student to progress individually, AI can adapt instructional methods to meet diverse needs (Kazu & Özdemir, 2009, cited in Bayburt & Eğin, 2021). Continuous feedback mechanisms, automated grading, and intelligent tutoring systems streamline instructional processes and reinforce student understanding. Additionally, AI enables global connectivity and learning without temporal or spatial limitations, supporting distance education platforms (Murphy, 2019).

AI-driven tools can serve as virtual teachers, delivering targeted explanations, assessing students' comprehension, and revisiting misunderstood concepts. Such systems can alleviate teachers' administrative burden by automating grading and performance tracking (Karaca & Telli, 2019). Moreover, predictive analytics derived from AI systems can help identify students at risk of dropping out or falling behind academically, prompting timely interventions.

Existing Research and Gaps

A growing body of literature highlights AI's importance in education (Arslan, 2017; Coşkun & Gülleroğlu, 2021; İşler & Kılıç, 2021), underscoring both the history and practical classroom applications of AI. However, research explicitly examining teachers' perspectives on AI remains limited. For instance, Çam et al. (2021) explored prospective teachers' awareness of AI, while Aktaş (2021) investigated how school administrators and teachers perceive AI in education. Building on these studies, the present research addresses the gap by focusing on in-service teachers' knowledge of and attitudes toward AI's role in educational settings.

Research Purpose and Questions

This study aims to examine teachers' opinions on the use of artificial intelligence in education. By elucidating their level of AI knowledge and exploring how AI could shape teaching and learning processes, the findings aim to guide relevant stakeholders in effectively integrating AI into educational systems. Specifically, the study seeks to answer the following sub-questions:

1. What are teachers' levels of knowledge about artificial intelligence?
2. What are teachers' opinions on the use of artificial intelligence in education?
3. To what extent are teachers familiar with current AI applications in education?
4. What do teachers believe about the relationship between AI and academic success?

Method

A qualitative research method was employed in this study. Qualitative research utilizes observation, in-depth interviews, and document analysis (Strauss & Corbin, 2014). Additionally, qualitative research is an approach that involves the evaluation of verbal data and aims to explore rather than generalize (Bülbül, 2016. Cited in Aydoğdu et al., 2017).

The study aimed to elucidate teachers' opinions on using artificial intelligence in education. For this purpose, in-depth interviews were conducted based on 10 questions in the data collection tool with 20 teachers and 3 relevant experts. The interviews were recorded, transcribed, and then confirmed by the participants. The verbal data obtained were analyzed through themes and codes to reach accurate conclusions.

Research Design

In this study, the qualitative research method of phenomenology design has been utilized. Phenomenological studies aim to identify and interpret personal perceptions regarding a phenomenon (Yıldırım & Şimşek, 2008). To achieve this, researchers can engage in deep dialogues with participants to explore the topic (phenomenon) (Büyüköztürk et al., 2014). Phenomenological studies enable researchers to gain insights into individuals' thoughts, perceptions, and experiences related to a phenomenon (Kocabıyık, 2015).

The focus of this study is to determine teachers' opinions on the use of artificial intelligence in education. For this purpose, data were collected and evaluated by interviewing science and information technology teachers with specific proficiency levels and artificial intelligence knowledge. Thus, teachers' views, perceptions, and ideas on the subject were obtained.

Study Group

When determining the study group for qualitative research, attention should be paid to aspects such as content, planning, and quality of the data to be investigated. The number of individuals to be interviewed is determined in line with the study's objectives (Morse, 2000). In phenomenological studies, individuals to be investigated should know the subject. The number of selected individuals should be 10-15 (Starks and Trinidad, 2007). In this study, the study group was determined using purposive sampling to determine teachers' opinions on using artificial intelligence in education. The research group was selected through criterion sampling, one of the purposive sampling methods. In criterion sampling, individuals who meet certain conditions or criteria are included in the research group (Büyüköztürk et al., 2008). The researchers can determine the criteria (Marshall & Rossman, 2014). The study on teachers' views on using artificial intelligence in education considered a certain level of knowledge about artificial intelligence as a criterion. Therefore, Computer Science teachers and Science teachers who followed the subject knew about it and participated in projects and competitions related to the topic were selected.

Table 1

Demographic Information of the Participants

Participants	Demographics	Frequency	%
Gender	Male	11	%55
	Female	9	%45
Branch	Science	15	%75
	ICT	5	%25
Education	Undergraduate	16	%80
	Graduate	4	%20
Seniority	Between 0-10 years	8	%40
	Between 10-25 years	12	%60
Age	20-40 years	17	%85
	40-60 years	3	%15

According to Table 1, 55% (11) of the teachers participating in the study are male and 45% (9) are female. While 75% (15) of the teachers are in the Science branch, 25% (5) are in the ICT branch. 80% (16) of the teachers participating in the study have a bachelor's degree, and 20% (4) have a master's degree. Those between 0-10 are 40% (8), and those between 10-25 are 60% (12). Finally, 85% (17) of the teachers are between 20-40, while 15% (3) are between 40-60.

Data Collection Tool

In qualitative research, methods such as observation, structured or semi-structured interviews, focus group discussions, discourse, and textual analysis are used to collect data (Baltacı, A. 2019). Since the study utilized a semi-structured interview technique, a semi-structured interview form prepared by the researcher that was suitable for this method was employed. Necessary literature reviews were conducted during the preparation of the form. Feedback from 3 experts, including two from the field and one linguistics expert, was sought, and necessary revisions were made.

The interview form contains questions through which participants' opinions on using artificial intelligence in education can be accessed. The questions are designed to be objective and non-directive, adhering to the purpose of the study and formulated in an open-ended manner. Open-ended questions provide freedom to respondents during interviews and can help relax the interview environment (MEB, 2012). The questions addressed to the participants in the semi-structured interview form are shown in the appendix (Appendix 1). Through these questions in the form, teachers' opinions were obtained on their knowledge about artificial intelligence, their views on the use of artificial intelligence in education, its impact on academic achievement, and similar topics.

Data Collection Process

This study was conducted using the phenomenological method. In this method, interviews with participants are commonly conducted to collect data (Yıldırım & Şimşek, 2008). Interviewing is a method where the researcher asks participants questions to gather information on a particular topic (Christensen, Johnson, & Turner, 2015; Türnüklü, 2000). In phenomenological studies, oral narratives and written expressions convey human experiences (Van Manen, 1984. cited in Baker et al., 1992). Interview types commonly used in educational research are generally categorized into three groups: unstructured, structured, and semi-structured (Holstein & Gubrium, 1997). When collecting teachers' views on the use of artificial intelligence in education, the semi-structured interview method was employed with the participants. In this method, the researcher asks participants predetermined questions to elicit their opinions and experiences on a particular topic. Semi-structured interviews provide a certain level of standardization while also being flexible, making them a suitable method for research in this field (Türnüklü, 2000). In this study, interviews were conducted with the identified study group. During these interviews, participants were asked the questions from the semi-structured interview form. In-depth discussions were held with the participants. The researcher asked the prepared questions, and participants' responses were recorded as audio. Subsequently, the audio recordings were transcribed into text, and confirmation was obtained from the participants.

Data Analysis

In qualitative research, data analysis focuses on extracting and interpreting meanings from the examined phenomena, constituting the most crucial stage of the research process (Flick, 2013). In this study, data gathered from interviews were analyzed using the content analysis method, a standard procedure in qualitative research. This method entails segmenting the data into meaningful units, or "codes." Once generated, codes are grouped into themes based on shared characteristics. These codes and themes are organized into a coherent framework, facilitating reader comprehension. Finally, in the "interpretation of findings" phase, the interrelations among codes and themes are examined, completing the analysis (Yıldırım & Şimşek, 2013).

All interview data were transcribed verbatim and subsequently confirmed by participants to ensure accuracy. After transcription, the data were coded, and the resultant codes were aggregated into themes and subthemes. Any initial disagreements in theme identification were resolved through consensus, culminating in a finalized thematic structure. To verify the study's reliability, Miles and Huberman's (1994) reliability formula—calculated as $\text{Agreement} \div (\text{Agreement} + \text{Disagreement})$

Agreement÷(Agreement+Disagreement)—was employed. Because the derived value exceeded 70%, the study was deemed reliable. Ultimately, the research team achieved complete consensus on the identified themes, yielding a reliability coefficient of 0.84.

Validity and Reliability

In scientific research, the credibility of the results is crucial. To ensure this credibility, the concepts of validity and reliability are utilized. In quantitative research, validity and reliability are generally achieved by thoroughly testing the data collection tools and sharing this with the readers. However, in qualitative research, validity and reliability are ensured in a slightly different manner (Yıldırım and Şimşek, 2013). Instead of validity and reliability, concepts such as credibility, the accuracy of the results, and the researcher's competence would be more appropriate (Krefting, 1991). According to Guba and Lincoln (1982), credibility should be used instead of validity and reliability in qualitative research. Credibility in the research is grouped under four headings to establish credibility: credibility, dependability, confirmability, and transferability. Long-term interaction interviews were conducted to increase the credibility of the research. The researcher's ideas and opinions were not reflected in the participants throughout the interviews, and an objective process was followed. After the interviews were recorded, they were transcribed, and written participant confirmation was obtained. A purposeful sampling was conducted to ensure the transferability of the research. This study aims to determine teachers' opinions regarding using artificial intelligence in education. Participants included Science and Computer Science teachers with a certain level of knowledge, following the inclusion/exclusion criteria. Furthermore, participants' extensive demographic information was collected to ensure transferability. To ensure the reliability of the study, data were sent to other researchers and experts for researcher triangulation. The reliability coefficient was found to be .84 according to the formula of Miles and Huberman (1994) through code and theme comparison. Finally, methods such as objectivity and researcher triangulation were used to ensure the confirmability of the research.

Findings

In our study on teachers' opinions regarding using artificial intelligence in education, teachers were interviewed and asked questions. Themes and codes were derived from the responses. Below, these themes and codes are presented in table format.

Table 2

Themes and Codes Identified in the Research

Themes	Codes		
Theme 1: Definition of Artificial Intelligence	Learning machines (f=10)	Imitation (f=6)	Computer program (f=8)
Theme 2: Purposes of Using Artificial Intelligence	Language learning (f=8)	Personalized education (f=7)	Student tracking (f=7)
Theme 3: Level of Utilization of Artificial Intelligence	Low level (f=12)		
Theme 4: Examples of Artificial Intelligence Applications in Education	Coursera (f=5)	Education Informatics Network Assistant (f=8)	Python (f=4)
Theme 5: The Use of Artificial Intelligence in Education	Should be used (f=17)	Positive appraisal (f=8)	
Theme 6: The Relationship Between Artificial Intelligence and Academic Achievement	Increasing success (f=13)	Positive relationship (f=6)	Directly proportional (f=4)
Theme 7: Criteria for Artificial Intelligence Implementation	Feedback provision (f=9)	Suitability for student level (f=5)	Evaluation (f=5)
Theme 8: Duties of Teachers	Receiving education (f=6)	Being directive (f=6)	Guiding (f=5)
Theme9: Concerns Regarding Artificial Intelligence	Replacing the teacher (f=8)	Data security (f=7)	Emotional deficiency (f=6)
Theme 10: Future Applications of Artificial Intelligence	Education without teachers (f=7)	Virtual classrooms (f=5)	Vocational guidance (f=6)

Findings Regarding the Definition of Artificial Intelligence

In a question about the definition of artificial intelligence teachers, answers such as self-learning machines, imitation of humans, and computer programs have emerged as prominent. The theme and codes of these answers are shown in table 3 below.

Table 3
Findings Regarding the Definition of Artificial Intelligence

Themes	Frequencies	Example Quote
Learning Machines	T1, T2, T3, T4, T5, T6, T9, T10, T12, T17	T3: "It is a machine that learns based on humans."
Personalized education	T1, T2, T7, T8, T11, T16	T1: "We can say that artificial intelligence imitates human intelligence."
Computer program	T1, T6, T9, T10, T13, T15, T18, T20	T10: "We can also say that computer programs can learn."

According to the data on the definition of artificial intelligence, the most repeated answer is "learning machines." In this regard, T4 stated, "We can refer to pre-programmed learning machines." T9, on the other hand, stated about the code of learning machines, "The key phrase we determined in the definition of artificial intelligence is machine learning." When examining the responses to defining artificial intelligence, imitation comes second. Indeed, T2 stated, "It imitates human intelligence to perform tasks." One of the frequently repeated answers by the interviewees is that artificial intelligence is a computer program. Participant T1 answered this question: "It is a computer program that mimics human intelligence."

Findings Regarding the Use of Artificial Intelligence in Education

In the question posed to teachers, 'What could be the purposes of using artificial intelligence in education?' answers highlighting personalized learning, language acquisition, and student tracking have emerged. Below are the themes and codes extracted from the responses to questions regarding using artificial intelligence in education.

Table 4
Findings Regarding the Use of Artificial Intelligence in Education

Themes	Frequencies	Example Quote
Language learning	T2, T3, T6, T10, T14, T15, T17, T20	T2: <i>"For the student to practice language learning."</i>
Personalized Education	T2, T5, T8, T11, T13, T14, T19	T11: <i>"Artificial intelligence can be used for personalized education."</i>
Student tracking	T1, T4, T9, T11, T15, T17, T18	T4: <i>"They can track students individually."</i>

According to the responses in Table 4, language learning is frequently mentioned. Indeed, respondent T10 stated, "We can use it for language learning." Another commonly repeated response is personalized education. T2 mentioned, "Personalized education can be conducted by preparing

suitable student plans.” Another purpose of using artificial intelligence in education is student tracking. T18 stated, “Artificial intelligence can track individual students.”

Findings Regarding the Level of Utilization of Artificial Intelligence in Education

The responses from participants regarding the current level of utilization of artificial intelligence in education are as follows.

Table 5

Findings Regarding the Level of Utilization of Artificial Intelligence in Education

Themes	Frequencies	Example Quote
Low level	T1, T2, T4, T7, T8, T10, T11, T13, T14, T15, T18, T20	T8: “ <i>I believe it is not adequately utilized in schools.</i> ”

When examining Table 5, it is evident that many teachers perceive the use of artificial intelligence in education to be at a low level. T10 expressed, ‘The use of artificial intelligence in education is currently low.’ T20 stated, “I do not think it has become widespread in education yet.”

Findings Regarding Examples of Artificial Intelligence Applications in Education

The following codes were identified when teachers were asked about examples of artificial intelligence used in education.

Table 6

Findings Regarding Examples of Artificial Intelligence Applications in Education

Themes	Frequencies	Example Quote
Coursera	T1, T10, T13, T16, T19	T1: “ <i>A great artificial intelligence program for one-on-one teaching, individualized learning, and personalized tracking of learning differences.</i> ”
Education Informatics Network Assistant	T3, T6, T9, T11, T12, T14, T17, T20	T6: “ <i>The Education Informatics Network Assistant program, where we can access information and ask questions, is an artificial intelligence application.</i> ”
Python	T11, T13, T15, T18	T10: “ <i>There is a Python program for enhancing foreign language proficiency.</i> ”

When examining Table 6, the Coursera response stands out as one of the artificial intelligence applications currently used in education. T10 mentioned, “We can discuss a program called Coursera, which supports individual education.” Another prominent response is the Education Informatics Network Assistant. Three participants mentioned the Education Informatics Network Assistant as an example of artificial intelligence used in education. Indeed, T11 stated, “There is the Education Informatics Network Assistant program where students can find answers to frequently asked questions.” Another repeated response from participants is Python. T13 responded, “We can give the example of the Python program used in language teaching.”

Findings Regarding Perspectives on the Use of Artificial Intelligence in Education

The participants were asked about their views on using artificial intelligence in education. The codes identified based on the responses to this question are shown in the table below.

Table 7

Findings Regarding Perspectives on the Use of Artificial Intelligence in Education

Themes	Frequencies	Example Quote
Should be used	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12 T13, T14, Ö15, Ö16, Ö18	T5: <i>"I believe that with advancing technology, artificial intelligence should be integrated into the education process."</i>
Positive perception	T3, T4, T7, T9, T10, T12, T17, T19	T3: <i>"There is a positive relationship."</i>

According to Table 7, the most frequently given answer to the question about using artificial intelligence in education was 'should be used.' The majority of participants agreed that artificial intelligence should be used in education. On this matter, T6 stated, 'Since technology is a part of the lives of today's generation, artificial intelligence should be used in education.' At the same time, T18 responded, 'As teachers, I do not think we are 100% sufficient for today's students, so artificial intelligence should be used in education.' Another repeated response by participants was 'positive perception.' T4 answered this question: "Education should be intertwined with technology, and therefore, I view the use of it in education positively."

Findings on the Relationship Between Artificial Intelligence and Academic Achievement

Teachers were asked about the potential relationship between artificial intelligence and academic achievement. Based on the responses to this question, the following codes were developed.

Table 8

Findings on the Relationship Between Artificial Intelligence and Academic Achievement

Themes	Frequencies	Example Quote
Improving Academic Achievement	T2, T3, T5, T7, T9, T10, T11, T12, T13, T14, T16, T18, T20	T4: <i>" Academic achievement can be enhanced through artificial intelligence software."</i>
Positive Relationship	T1, T3, T8, T12, T14, T19	T1: <i>"I believe there will be a positive relationship between artificial intelligence and academic achievement."</i>
Being Proportional	T2, T4, T14, T15	T14: <i>" I believe there will be a direct correlation."</i>

According to Table 8, when teachers' opinions regarding the relationship between artificial intelligence and academic achievement are examined, it is observed that most participants believe that artificial intelligence applications will increase academic achievement. T2 said, "If it is compatible with personalized education plans, academic achievement will increase," while T3 stated, "I think it will significantly increase academic achievement." Another participant's response indicates a positive relationship between artificial intelligence and academic achievement. Indeed, the teacher of T3 stated, "There is a positive relationship." When we examine the table, we also see responses indicating a proportional relationship between artificial intelligence and academic achievement. T2 stated, "If

artificial intelligence is used effectively and accurately, I believe academic achievement will increase in proportion as we focus on personalized education.”

Findings Regarding Criteria for Artificial Intelligence Applications

The following codes have been extracted from the responses to the question, ‘What criteria should be present in artificial intelligence applications that you will implement in your classes?’

Table 9

Findings Regarding Criteria for Artificial Intelligence Applications

Themes	Frequencies	Example Quote
To give feedback	T1, T4, T9, T10, T11, T13, T15, T16, T19	T9: <i>“It should provide the necessary feedback with artificial intelligence support.”</i>
Suitability for student-level	T2, T8, T11, T12, T20	T8: <i>“ I expect it to be at my student’s level.”</i>
Evaluation	T4, T9, T10, T14, T17	T17: <i>“It should make sufficient assessments with the feedback received.”</i>
Identification of learning deficiencies	T4, T7, T11, T15, T16, T18	T11: <i>“What are the learning deficiencies? These should be identified.”</i>

According to Table 9, the most desired criterion for artificial intelligence is its ability to provide feedback. A large majority of teachers want the artificial intelligence they will implement in their classes to have the ability to provide feedback. For instance, T1 stated, “Does the artificial intelligence I implement track my student’s progress and provide feedback to me?” Another criterion highlighted by participants is that artificial intelligence should be suitable for the student level. T11 expressed this viewpoint: “First and foremost, artificial intelligence should be appropriate for the student level.” Another response from the table is regarding the ability of artificial intelligence to conduct assessments. Indeed, T9 mentioned, “I want it to evaluate the overall process based on the data input by the teacher, manage, and advance the teaching process.” The last response in the table is about the ability of artificial intelligence to identify learning deficiencies. T16 expressed this by stating, “It should be able to identify which topics or question types the student is lacking in, which I may not be able to detect.”

Findings Regarding the Responsibilities of Teachers in the Use of Artificial Intelligence in Education

The codes from the responses to the question ‘What responsibilities can teachers have in using artificial intelligence in education?’ are shown in the table.

Table 10

Findings Regarding the Responsibilities of Teachers in the Use of Artificial Intelligence in Education

Themes	Frequencies	Example Quote
Receiving education	T1, T7, T8, T10, T12, T18, T20	T8: <i>“Teachers should use artificial intelligence with the training they receive.”</i>
Being guiding	T3, T6, T9, T11, T17, T19	T3: <i>“They should guide the students.”</i>
Being a guide	T4, T6, T10, T12, T14	T6: <i>“In the 21st century, a teacher who is a guide should also guide in this matter.”</i>

According to Table 10, teachers' responsibilities in using artificial intelligence in education include receiving education/training, being mentors, and guiding students. The most common response based on the questions is to guide the students. T6 stated, "I think guiding the students is a great responsibility." Another repeated response from participants is that of being a mentor. For instance, T14 stated, "I believe the teacher should be in a mentor position here." The last repeated response in the table is that teachers should receive education/training on artificial intelligence. T10 expressed this by stating, "The teacher should improve himself/herself in this regard and should not remain passive."

Findings Regarding Concerns About the Use of Artificial Intelligence in Education

The concerns regarding the use of artificial intelligence in education were asked during discussions with teachers, and the resulting codes from the responses are shown in the table below.

Table 11

Findings Regarding Concerns About the Use of Artificial Intelligence in Education

Themes	Frequencies	Example Quote
Replacing the role of the teacher	T1, T2, T10, T11, T13, T15, T17, T19	T2: "The fear of being replaced by teachers concerns me the most ."
Data security	T2, T5, T10, T12, T14, T18, T20	T5: "It could be problematic if the data would be in hackers' hands. "
Lack of emotion	T1, T7, T10, T13, T15, T18	T1: "Since our students obtain social and emotional communication from teachers, artificial intelligence may be unable to fulfill this. "

When examining Table 11, the most frequently repeated response is the fear of replacing the role of the teacher. T1 responded, "My biggest concern is that artificial intelligence will replace the teacher." Another frequently repeated response in the table is data security. T2 mentioned, "Despite the positive aspects of artificial intelligence, if it educates students on digital platforms, data may become vulnerable." Another frequently repeated response to this question is the potential lack of emotions in students. T18 said, "My concern is the potential lack of emotions that may arise in students."

Findings Regarding Future Artificial Intelligence Applications

The following codes have been formed based on the responses of participants to the question, 'Which artificial intelligence applications would be used in the future?'

Table 12

Findings Regarding Future Artificial Intelligence Applications

Themes	Frequencies	Example Quote
Education without teachers	T7, T8, T10, T12, T15, T16, T19	T8: "It can replace the role of the teacher. "
Virtual classrooms	T9, T10, T11, T14, T17	T10: "Virtual classrooms can be created. "
Career Guidance	T3, T5, T4, T13, T14, T20	T14: Professional guidance can be provided.

Table 12 shows that future artificial intelligence applications may include education without teachers, virtual classrooms, and career guidance programs. Regarding education without teachers, statement T7 suggests the possibility of teaching classes in a school without teachers using artificial intelligence. As

for virtual classrooms, statement T9 mentions the potential for creating such classrooms. Participants have expressed views on the ability of artificial intelligence to guide students toward professions based on their interests and abilities. Indeed, statement T20 indicates belief in the capability to channel students correctly into suitable careers, stating, “I think students can be channeled into the right careers in the right way.”

Conclusion, Discussion, and Recommendations

In our study on teachers’ perspectives regarding using artificial intelligence (AI) in education, participants described AI primarily as “learning machines” that mimic human intelligence and operate as computer programs. Many teachers highlighted that AI systems learn from data and adapt based on specific characteristics. When discussing the purpose of AI in education, teachers frequently mentioned its potential for personalized learning, language instruction, and student monitoring. They noted that AI could tailor instruction to individual student needs, allowing learners to progress at their own pace. Despite these promising aspects, most teachers expressed low confidence in the current state of AI utilization in schools, perceiving its implementation as inadequate.

Teachers provided examples of AI applications, such as Coursera, Eba Asistan, and Python-based programs. They indicated that Coursera supports individualized education, Eba Asistan addresses frequently asked questions, and Python is employed for language teaching. Unanimously, all participants agreed on the potential benefits of integrating AI into education, suggesting that it could enhance academic achievement by identifying learning deficiencies and enabling personalized instruction.

Regarding their professional roles, teachers emphasized that successful AI integration requires initial training and ongoing mentorship to guide students effectively. However, they also expressed concerns, the most prominent being the fear that AI might eventually replace human teachers. Other concerns included data security risks and the inability of AI systems to replicate the social and emotional aspects of human interaction, which are essential for holistic student development.

Teachers envisioned future AI applications that could support classrooms without teachers, virtual learning environments, and vocational guidance systems. Such innovations, they suggested, would allow education to transcend traditional spatial and temporal constraints and provide early career counseling based on individual strengths.

These findings align with previous research (e.g., Çam et al., 2021; Tekgüç & Adalier, 2019; Sheikh, 2020; Nabiyeve & Erümit, 2020) that highlights AI’s potential for personalized education while also underscoring critical concerns about its current limitations. Although the current use of AI in education remains insufficient, teachers believe that with technological advancements, AI will soon become an indispensable component of educational practice. To facilitate this transition, there is a need for enhanced support systems, including robust infrastructure, targeted teacher training, and rigorous development of AI applications that complement—rather than replace—the role of human educators.

In a research study on teachers’ perspectives regarding using artificial intelligence in education, teachers explained the definition of artificial intelligence, such as learning machines, mimicking human intelligence, and computer programs. Among these explanations, the definition of learning machines was the most commonly given response. Teachers who provided this answer stated that artificial intelligence systems are machines that learn through specific characteristics they possess. Regarding the purpose of using artificial intelligence in education, teachers expressed opinions about language learning, personalized education, and student monitoring. The most common response in this regard was personalized learning, where education tailored to individual needs is conducted. Teachers mentioned that with artificial intelligence, education tailored to the pace and needs of each student can be provided. Almost all teachers expressed low confidence regarding using artificial intelligence in education. Teachers perceive the current level of artificial intelligence utilization in education as inadequate.

Examples of using artificial intelligence in education include programs such as Coursera, Eba Asistan, and Python. It is stated that Coursera can provide individual education, Eba Asistan can offer answers to frequently asked questions, and Python is used in language teaching. When asked about their opinion on using artificial intelligence in education, all participants unanimously agreed it should be

used. All teachers believe that using artificial intelligence in education would be beneficial. When looking at the relationship between artificial intelligence and academic achievement, most teachers said that artificial intelligence would increase academic achievement. It is thought that with artificial intelligence applications, learning deficiencies can be identified, and personalized education can be provided, leading to increased academic success.

Regarding teachers' responsibilities in using artificial intelligence in education, answers related to receiving education, guiding, and being mentors were given. Teachers believe that education is necessary to acquire the ability to use artificial intelligence. However, they also mentioned that guiding and mentoring students should be fulfilled during the process.

When teachers were asked about their concerns regarding artificial intelligence, the most common response was the fear of replacing teachers. Teachers worry that artificial intelligence applications in education could push teachers out of the process as time passes. Another concern expressed by teachers is the security of student-related data. Teachers mentioned their anxiety about data theft being shared in the digital world. Another concern teachers have regarding artificial intelligence is the lack of emotion. Considering that artificial intelligence applications lack social and emotional aspects, there is concern that students may not develop these aspects. Teachers have mentioned that future artificial intelligence applications could include education without teachers, virtual classrooms, and vocational guidance. It has been stated that education can be conducted in a digital environment without the need for teachers. It has been explained that with virtual classrooms created in this environment, education can be conducted without time and space constraints. Another potential application in the future could be vocational guidance. With artificial intelligence applications, students' abilities can be identified from a young age, guiding them toward a suitable profession.

Most teachers have described artificial intelligence as learning machines, which aligns with the findings of Çam et al. (2021). Indeed, the participants in this study also defined artificial intelligence as machines that learn from existing data. The notion that artificial intelligence can provide personalized education is consistent with the findings of the same study. The research above noted that artificial intelligence could address students' deficiencies and provide individualized education by conducting personalized assessments. When teachers were asked about their concerns regarding artificial intelligence in our study, the responses included fears of replacing teachers and emotional deficiencies. These results are similar to the findings of Çam et al. Indeed, the participants in this study also mentioned that artificial intelligence could potentially replace humans and have emotional deficiencies. Artificial intelligence in education may not lead to students' desired social and emotional development. Students with less interaction with their surroundings may experience loneliness and emotional deficiencies. This situation parallels the findings of the studies.

When teachers were asked about their opinions on using artificial intelligence in education, it was observed that all teachers unanimously agreed on the necessity of using artificial intelligence in education. These data align with the findings of Tekgüç and Adalier (2019). The mentioned study also discussed the necessity of using artificial intelligence in education. The purpose of using artificial intelligence in education, as mentioned by teachers, is personalized education. This aligns with the findings of Sheikh (2020). Indeed, it has been noted in this study that artificial intelligence can be used in personalized education.

Nabiyev and Erümit (2020) also explained in their study that artificial intelligence can be used in personalized education. Our study findings are similar to those of Nabiyev and Erümit. Artificial intelligence in various fields will eventually be used in education over time. With the transition of education and teaching to the digital world, the scope of artificial intelligence in education will gradually expand. Individuals can receive personalized education at their own pace and according to their needs. This situation is consistent with the findings of the studies conducted.

Teachers' use of artificial intelligence applications in today's education system is insufficient. However, with the rapid advancement of technology, artificial intelligence will become an indispensable part of education and teaching in a short period of time. Developed countries foresee this and continue their efforts to integrate artificial intelligence systems into education. Our country must also make necessary efforts to avoid falling behind. Universities and scientists producing

artificial intelligence applications should be supported. Units dealing with this issue should be established in private and public institutions, and existing ones should be improved. Careful consideration should be given to integrating prepared artificial intelligence applications into education. When artificial intelligences are used in education, they should be tailored to the level of students. They should provide individual learning opportunities to students and provide them with feedback. Analyzing students' abilities and interests at a young age, they should guide appropriate career choices. Physical infrastructures should be prepared to enable the use of artificial intelligence systems throughout the country. Necessary training should be provided to teachers who will use these systems. Artificial intelligence should never replace teachers; instead, it should be used under teacher guidance to enhance the quality of education.

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Cultivating Digital Citizens: Positive Technological Development and Children

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Abstract

This review article aims to introduce the Positive Technological Development (PTD) framework in the context of existing literature. The paper provides a theoretical explanation of how the PTD approach can be used in the teaching-learning process. The dimensions and components of the PTD framework are outlined. The paper discusses the multifaceted relationship between technological developments and educational environments and offers suggestions on how technology can be used most effectively to make individual and societal contributions. The PTD framework is presented as a rational approach to using technology to support positive development in children, promoting creativity, critical thinking and social engagement while reducing negative impacts. The study emphasizes the importance of integrating technology into educational settings to support positive development and improve learning outcomes and advocates for the thoughtful and developmentally appropriate design of digital experiences for children.

Keywords: Early childhood education, positive technological development, children.

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Introduction

Technology and digital media are revolutionizing our society today, becoming a big part of our entertainment, social life and now our classrooms. Both the US Department of Education (2017) and NAEYC (2012) have recognized that Educational technology is a rapidly growing field and can offer educators innovative ways to teach material and complement a child's learning using different skills. In 2017, the National Educational Technology Plan specifically stated that "technology can play a powerful role in transforming learning" (US Department of Education Office of Educational Technology). NAEYC has also reported that technology and digital media should be incorporated into the early learning curriculum because it is important to spark curiosity at this age and technology provides a creative outlet for children to explore different concepts (NAEYC, 2012). Educators should be aware that these tools can be effective in early childhood and early primary education and should be integrated into classrooms.

Technological development is associated with positive impacts on various aspects of society and the economy. Studies have shown that technological development positively affects production and economic growth (AL-Refai et al., 2016). Moreover, while technological innovation contributes significantly to regional economic development (Xiao et al., 2022), technology has positive impacts on employment policies and entrepreneurship, highlighting the broader positive effects of technological advances (Al-Saleh and Allen, 2019; Canbay, 2020).

Technology, which has an impact on every aspect of life, has also found an echo in the field of education. The relationship between technological development and educational environments is complex and multifaceted. Research shows that children are increasingly exposed to sophisticated technological environments, including video games, virtual spaces and social media (Freier & Kahn, 2023). This exposure affects children's learning experiences, social interactions and personal development (Demetriou & Nikiforidou, 2019). While there are generally positive views about the benefits of technology on children's intellectual, social and emotional development (Jabbar et al., 2019), there are also serious concerns about the potential risks associated with technology (Jabbar et al., 2019; Oktafia, 2020). Although the assumption that technology helps individuals improve their quality of life has been confirmed by many studies, the impact of new technologies and media on well-being and positive functioning is still somewhat controversial (Riva et al., 2012). For this reason, the design of technological environments for children today needs to take into account various aspects of child development, including embodied and social experiences (Freier, 2023). In this context, it has become a necessity to design educational environments to respond to the problems arising from new technologies (Costabile & Spears, 2012).

Using computers in the context of computer literacy involves a set of instrumental as well as epistemic competencies and confidence (Resnick, 1996). Stating that information technology is constantly changing over time, Resnick (1996) emphasized that there is no value in learning to use these tools, but rather technological competence is important. Similarly, Bers (2006) states that in a digital age where technology plays a role in many aspects of a child's life, it is necessary to have the competence and confidence to use computers, but using a computer is not an end in itself. It is equally important to develop character traits that will serve children to use technology safely to communicate and connect with others, and to provide opportunities for children to use computer skills and new ways of thinking to create a better world. Thus, he emphasizes that the goal is to promote positive development through the use of technology (Bers, 2006). Studies on the impact of technology on children's development have highlighted both positive and negative effects and emphasized the importance of guidance and appropriate approaches to technology use (Gottschalk, 2019; Lau et al., 2011; Ricci et al., 2022). Ravikumar (2022) stated that educators have some negative perceptions about the use of technology and digital media in their classrooms. However, he emphasizes that there are some ways in which we can address technology in a way that provides an alternative perspective, such as PTD. Therefore, as Bers et al. (2012) state, the Positive Technological Development (PTD) Framework functions as a theoretical framework that aims to provide positive behaviors that children can develop when they interact with digital learning technologies.

The PTD framework provides a rationale for using technology to support children's positive development (Bers, 2010). This approach emphasizes aligning technology-mediated behaviors with children's presence in appropriate developmental contexts (Vaala, 2012) and carefully considering the use of technology to avoid its potential negative effects (Sigdel, 2017), while promoting creativity, critical thinking, and connection among children (Dhanain & Kumar, 2023). Offering a systems approach to understanding the overall impact of technology on development, the PTD model (Chau & Bers, 2006) aims to guide the creation of developmentally appropriate digital experiences.

Purpose and Importance of the Study

The integration of technology into education is important to promote positive development and improve learning outcomes. The Positive Technological Development framework emphasizes the value of developing character traits and civic engagement in educational settings through the use of technology (Bers, 2010). Innovative educational technologies contribute to increasing intellectual potential and social development in children (Holbozarova Nasiba Holbozar kizi, 2024; Kambarova, 2021), create new learning environments that support constructivist experiences (Fallas, 2011) and promise a more rapid, comprehensive and internalized form of knowledge acquisition (Granados Maguiño et al., 2020). While information and communication technologies (ICTs) offer numerous advantages, their effective implementation requires teachers' understanding and optimal use of these tools to improve the quality of education (Luz Marina Gómez Gallardo & Julio César Macedo Buleje, 2014). In this context, it is important to present and disseminate this approach in the literature in order to improve the quality of educational environments, facilitate teaching processes, and present technology with a set of internalized skills for social development.

Theoretical Basis

As a theoretical approach, PTG emerged from the integration of constructivist theories about learning with technology (Bers, 2018). The term positive in both Positive Youth Development (PYD) and PTG refers to the goal of engaging a young person in a good, healthy, and productive developmental trajectory (i.e., self and directed development) (Bers, Strawhacker, & Vizner, 2018). Although PTG is a theory that explains positive behavior, it does not adopt an interventionist perspective or a design approach. PTG incorporates the design of educational processes and focuses on technologies as tools to promote change. Whereas PGG describes a naturally occurring phenomenon (i.e. positive development), PTG provides methods and tools to design experiences where positive development is more likely. The PTG framework asks “how can the learning experience and learning space be designed to support cognitive, personal, social and moral development? How can these designed experiences promote developmental milestones for healthy and productive psychosocial growth at every stage of growth?” (Bers, Strawhacker, & Vizner, 2018). Therefore (Bers, 2018), PTG refers to how to create environments that support positive behaviors using technology as the main goal of positive technological development.

From a theoretical perspective, PTG integrates ideas from the fields of computer-mediated communication, computer-supported collaborative learning, and constructivist learning with technology with research in applied developmental science and positive youth development. In short, PTG focuses on two interrelated core issues:

- (1) The design and evaluation of technology-based psychoeducational programs and experiences that aim to assist in the positive use of technology,
- (2) Using technology to learn new things, express oneself in creative ways, communicate, take care of oneself and others, and contribute to society while developing one's own sense of identity based on personal and moral values (Bers, 2010).

In this context, positive technological development is outlined by two main pillars. The first is the Constructivist Approach and the second is Positive Youth Development (PYD). These approaches are detailed below.

Constructivism

The understanding of learning based on children's experiences was based on the views of Pestalozzi, Montessori, Dewey and Piaget and developed as constructionism with Freire and Papert. Piaget's theory of cognitive development created a framework for understanding children's ways of thinking and learning at different developmental stages (Ackermann, 2001). Piaget's definition that children do not receive knowledge passively but rather play an active role in constructing knowledge (Piaget, 1964) has fundamentally affected education and the view of education. Dewey's concept of "learning by doing", which was strengthened by his view that "school should be life itself", has influenced educational approaches, models and programs. Vygotsky, one of the important theorists of the constructivist approach, emphasized that children construct knowledge through their experiences with adults and peers and cultural tools that provide them with scaffolding (Vygotsky, 1980).

Seymour Papert led children to learn by design through his work with Piaget and the LOGO program he developed to support children's mathematical skills (Ackermann, 2001). Papert took constructivism one step further by using the concept of constructivism as "constructing knowledge structures" (Bers, et al., 2012). While Piaget's theory emphasized that knowledge is constructed in our minds, Papert's theory drew particular attention to the ways in which such internal structures are supported by structures in the world, such as using computers. Papert also noted that people are more likely to build internal knowledge and develop technological fluency in a playful way by creating an external object to think about (Bers, Doyle-Lynch, & Chau, 2012).

According to Papert (1991), the key to learning is to express one's feelings and thoughts and share them with others. The expression of ideas takes place when they are transformed into concrete and shareable products (Ackermann, 2001; Papert, 1991). Contrary to Piaget, Papert (1994) sees knowledge not only as a commodity to be transferred, coded, stored and reapplied, but also as a personal experience to be constructed and emphasized that a good way to support knowledge construction in one's mind is to build things in one's mind (Bers et al. 2012).

Seymour Papert's (1980) constructivist approach built on Piaget's constructivism and emphasized the importance of creating concrete products in the learning process (Ackermann, 2001; Harel & Papert, 1991). Papert's view of constructivism focuses on "learning to learn" and the role of tools, media and context in knowledge construction (Ackermann, 2001; Papert, 1993). This approach advocates for student-centered, project-based learning environments where children interact with technology to create meaningful products (Rob & Rob, 2018; Stager, 2005). Although constructivism and constructionism share some similar features, they differ in their emphasis on designing things that are meaningful for children, addressing their real-life problems, and using technology (Alanazi, 2016; Rob & Rob, 2018). Both theories have influenced instructional design and problem-based learning approaches (Savery & Duffy, 1995).

Key components of the theory include the use of technology as a learning material, especially computers and programming languages such as LOGO, to structure knowledge (Folk, 1981; Stager, 2007). Papert advocated "microworlds", which represent specially designed environments that facilitate natural learning of complex topics (Folk, 1981). The theory promotes personalization, computational thinking, and democratization of access to creative tools (Wellner & Levin, 2023). Constructionism focuses on the art of learning, the importance of making things and interacting with artifacts to enhance self-directed learning (Ackermann, 2001). Its practical applications include LEGO-based activities and computer programming to enhance problem-solving skills and metacognitive development (Beisser & Gillespie, 2003).

The constructivist approach encourages children to create meaningful products using technology. This approach emphasizes the development of basic competencies that enable children to become productive individuals, rather than merely consumers of technology. However, according to the constructivist approach, children's use of technology and production through technology alone is not considered sufficient. Children's ability to create meaningful products and share them constitutes the strengths of this approach. Therefore, the constructivist approach focuses on children's collaborative production through technology and the development of positive behaviors by sharing their products with society. The Positive Technological Development PTD approach has also formed the basis for

many technology-supported education programs and applications based on the constructivist approach, as it supports children in developing positive behaviors while producing through technology. This approach has been used in many applications to create a framework for supporting the negative effects of technology in technology-supported educational activities for children in a positive direction. In particular, Bers (2012, 2020), who introduced this approach, used the PTG framework in his applications with children to develop their coding and computational thinking skills while also supporting the development of their positive behaviors.

Positive Youth Development (PYD)

PYG is an approach to adolescent development based on the strengths of individuals, which emerged as an alternative to the disability-oriented models prevalent in the 1990s (Burkhard et al., 2020; Peterson, 2004). PYD views young people as resources to be developed rather than problems to be managed and emphasizes highlighting their unique talents, strengths, and potential (Benson et al., 2007; Romer & Hansen, 2021). The approach is based on developmental systems theory and focuses on aligning youth resilience with developmental assets (Lerner et al., 2005). Key elements of FGD include promoting the six Cs (competence, confidence, connection, character, civic engagement, and caring), supporting youth voice and agency, and developing supportive contexts such as families, schools, and communities (Schusler et al., 2018; Zarrett and Lerner, 2008). FGD research has transformed understandings of child nature, child-society interactions, and moral development (Damon, 2004). This approach promotes a variety of educational and out-of-school programs that aim to help young people develop and reach their full potential (Romer & Hansen, 2021).

Positive Technological Development

The main purpose of PTD is to examine in detail the tasks expected of a child growing up in this technological age in terms of all aspects of development and to lead the development of rich technology-based programs that are most appropriate for children and to provide a model for the optimal evaluation of these programs. In today's digital age, the starting point of the computer literacy movement is to support society to live a more meaningful life to make the world a better place and to guide children in the positive use of technology. At this point, the most common misconceptions are “teaching children to use technology to accomplish specific tasks”, “designing projects that only make sense to them” or “helping them to program”. However, the Positive Technological Development approach creates meaning beyond these commonly attributed tasks, focusing on the multidimensional evaluation of environments to create meaningful interactions for children and society (Bers, 2006; 2010).

A natural extension of the computer literacy and technological fluency movements that have influenced the world of educational technology, the Positive Technological Development framework (PTD) is differentiated by adding psychosocial, social and ethical elements to the cognitive components. In the modern age, technology occupies a large part of a child's life. For this reason, although having the competence and confidence to use a computer is considered an essential skill for children, it is not sufficient on its own. The ultimate goal of technology is not only to teach children how to use computer technologies, but also to use technology safely to communicate and connect with others. Developing character traits that enable children to use technological innovations for these purposes is one of the primary goals of PTD. In addition, providing opportunities for children to build a better, meaningful and livable world by demonstrating their computer skills is also a fundamental principle of the approach (Bers, 2010).

In its most general definition, Positive Technological Development (PTD) involves the purposeful design and development of technology to support individuals' psychological well-being, development and individual strengths (Mirković et al., 2018; Riva et al., 2012). The goal of PTD is to create technology that promotes positive outcomes and empowers human potential (Calvo & Peters, 2014). PTD frameworks are designed to promote healthy development in technology-rich learning environments (Strawhacker & Bers, 2018). Positive technology and computing approaches provide basic design principles and guidelines for developing interventions that support individual strengths and psychological development (Mirković et al., 2018). Furthermore, the design of early childhood

makerspaces is guided by the PTD framework to facilitate positive technological development in educational settings (Bers et al., 2018).

Positive Technological Development (PTD) is a framework that explores how technology can support youth development and well-being beyond computer literacy (Bers, 2010). Emphasizing the use of technology to promote positive experiences, personal growth, and social connectedness (Botella et al., 2012; Riva, 2012), PTD synthesizes cognitive, psychosocial, social, and ethical components to guide the design and evaluation of technology-rich programs for youth (Bers, 2010; Chau & Bers, 2006). This approach aligns with the principles of Positive Psychology, which focuses on enhancing emotional quality, engagement and commitment through technology (Riva et al., 2012). Positive technologies, including serious games, are categorized according to their impact on hedonic, eudaimonic or social well-being (Argenton et al., 2014; Distéfano et al., 2015). The PTD framework provides a comprehensive model for understanding the impact of technology on youth development and guides the design of educational programs that use technology to promote positive outcomes (McKnight, 2013). Research shows that the PTD framework is used and effective in technology-supported education practices (Bers, 2001; 2006; 2008; 2010); Bers, Doyle-Lynch, & Chau, 2012; Bers, González-González, Armas-Torres 2019; Bers, Strawhacker, & Vizner, 2018; Pugnali, Sullivan, & Bers, 2017; Strawhacker & Bers, 2018).

Positive Technological Development Framework

Based on constructivism and Positive Youth Development, Positive Technological Development offers a holistic model that addresses the key elements of technology use. While the PYD approach offers a perspective that explains positive behaviors, it lacks an interventionist attitude and a design approach. Positive Technological Development basically emphasizes the concept of designing. However, technology comes to the forefront as a tool to promote change. This is where Positive Technological Development differs most from Positive Youth Development. While Positive Youth Development addresses positive development, that is, phenomena that occur spontaneously, Positive Technological Development aims to increase the likelihood of positive development by utilizing tools and methods to design experiences (Bers et al., 2018).

Positive Technological Development, which advocates the necessity of designing, implementing, and evaluating educational programs based on current technologies to increase learning experiences in children, sought answers to the following questions based on the Positive Youth Development approach (Bers, 2012):

- How can the learning experience and learning space be designed for children from a social, individual, moral and cognitive perspective?
- Given children's developmental milestones, how can all these designed experiences support healthy and productive psychosocial progress in children at each growth stage?

The six developmental assets (competence, connectedness, character, confidence, trust, interest and contribution to civil society) in the Positive Youth Development approach set the stage for the overall framework of Positive Technological Development. The key distinction here, however, is that Positive Technological Development focuses on the expression of positive behaviors, especially by leveraging and actively using technology. These positive behaviors consist of the six Cs: content creation, creativity, choice of conduct, communication, collaboration, and community building. These behavior descriptions are also the positive behaviors that technology supports (Bers, 2007). However, the PTD framework provides a method to support these positive behaviors through the use of new technologies in different contexts (Bers, González-González, & Armas-Torres, 2019). Table 1 shows the relationships between the 6 Cs of Positive Youth Development (PYD) and the behaviors identified by Positive Technological Development (PTD).

Table 1.
Relationships between PYD and PTD Concepts

PYD Individual 6 C's of Assets	PTD Technology- Mediated Behaviors (6C)	Definition of PTD Structure
Competence	Content Creation	Creation of personally meaningful projects; young people as producers, not consumers; participatory online culture for young people to develop competences.
Confidence	Creativity	Supporting creative expression skills, sharing and reflection skills in order to promote self-efficacy in children.
Character	Choices of Conduct	Children have limited play spaces and freedom to make their own choices, gain experience by taking some risks, experience the consequences of their choices and reflect on the process. These experiences include social norms and moral-ethical issues.
Connection	Contact	It represents connections between children and adults. These connections take shape in synchronous and asynchronous forms, through multimedia tools (text, audio, voice, video, etc.). It is also based on the development of language and literacy skills.
Caring	Cooperation	It encourages children to interact with and respond to each other through defined shared tasks. These experiences, which emerge through social and technical support from both peers and adults, enable children to use technology to help others.
Contribution to Civil Society	Community Creation	It covers processes such as developing a sense of social responsibility, making visible the mechanisms of contribution to the public good, emphasizing the necessity of sharing responsibility, and children's participation in democratic processes.

According to the PTD framework, these elements are complex, interrelated and complementary in a dynamism that goes far beyond the conjugate definitions of PYD and PTD. A PTD model is presented, synthesizing six entities derived from PYD and six behaviors encompassing PTD. According to the PTD approach, our actions in daily life change who we are and who we are shapes our daily behavior choices. For this reason, there is a bidirectional relationship between the developmental assets identified within the scope of PDG and the technology-supported behaviors offered by the PTD framework (Bers et al., 2018).

The PTD theoretical model, which provides a framework to help understand how technology can be designed and used to promote positive behaviors and how these behaviors, in turn, can produce developmental assets, includes three components: individual outcomes, technology-mediated behaviors and practices. Figure 1 below shows how the Cs are interconnected and provides examples of how they can be implemented in a classroom setting (Bers, González-González, & Armas-Torres, 2019).

The first of the 6Cs in PTD is children's achievements/values/assets [competence, confidence, character, caring, connection, contribution and the other 6Cs are the skills that children need to develop [communication, collaboration, community building, content creation, creativity, choices of conduct]. According to Bers (2006; 2010; 2012) these outcomes are (see Figure 1):

Connection: Connection represents the capacity to build and maintain positive bonds and relationships through technology. Connection also encourages and supports collaboration between children in learning environments.

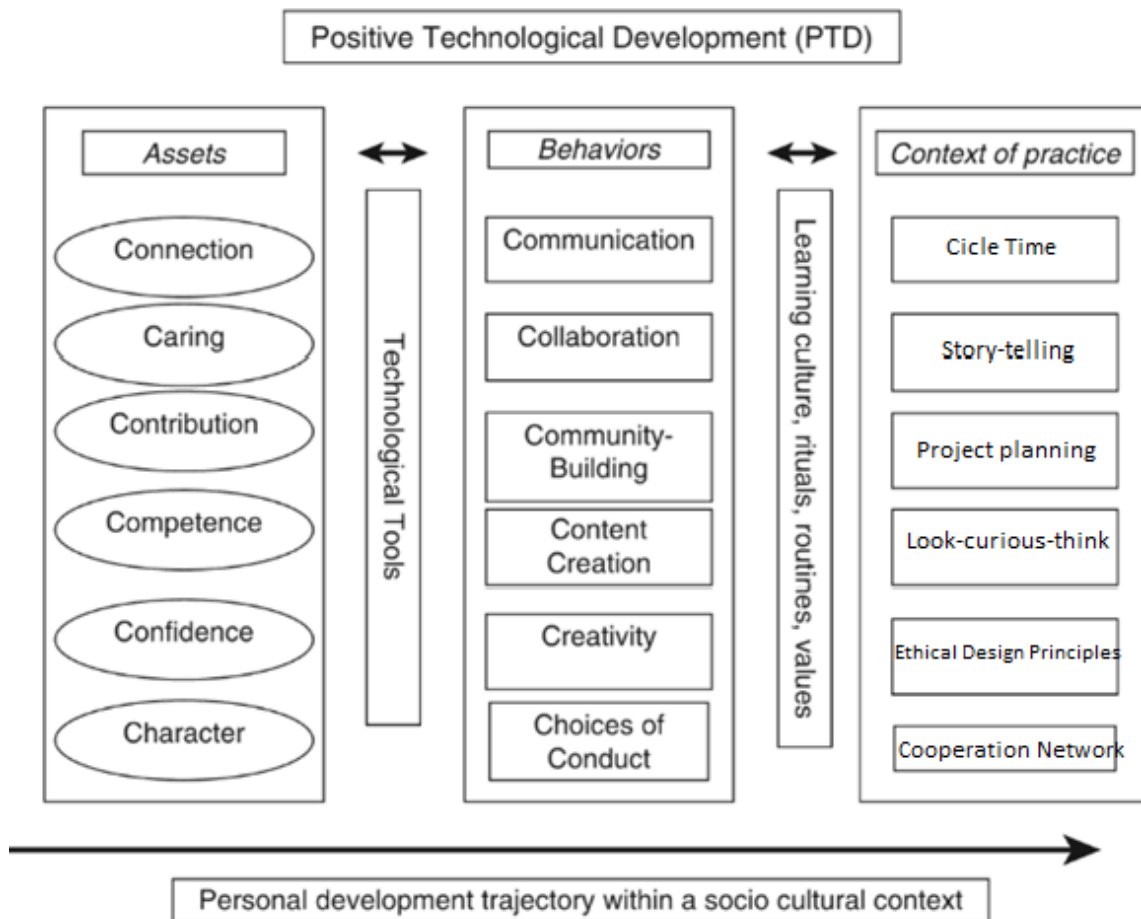


Figure 1. PTD Framework (Bers, 2010)

Caring: It means using technology with care and willingness to be responsive to the needs of others in the community. The basic idea of this approach is that people can communicate well through technology. For example, social media is one of the most important incentives for new ways of communicating.

Contribution: It is an orientation towards contributing to society by using technologies and developing new inventions to solve social problems. It prioritizes the contribution of technology to society building.

Competence: The creation of individually meaningful projects; children move from being mere consumers to producers.

Confidence: The development of self-efficacy through experiences that support children to express themselves in creative ways, share their ideas in a variety of ways and reason with the support of technology.

Character: In personality development, the process of choosing one's own behavior and facing the consequences of this choice plays an important role in shaping character. The sense of character functions as a compass for individuals along with a sense of responsibility during the use of technology. In modern life, especially in the digital world, it is important to be able to make behavioral choices. This is directly related to character.

The other part of the Positive Technological Development framework contributes to six individual behaviors highlighted as “communication, collaboration, content creation, community building, creativity and behavioral choices”. This section consists of various technology-based activities and behaviors that reinforce and bring these behaviors to light (Bers, 2012). Behaviors highlighted as 6Cs in PTG:

Content creation: The aim is to enable children to program computers and gain experience in working with sound, graphics, text, video and animation (Bers, 2012). In this way, children have the chance to be involved in Maker activities, programming computers and interacting with different materials. There is a strong relationship between children's competence and their ability to create content. In order to develop a sense of technological competence and skills in children, it is important to support their content creation skills. This content creation requires mastery of various computer applications for problem solving and debugging projects. According to DiGiacomo and Gutiérrez (2016), peer-supported content creation and play activities have a positive impact on young people due to the potential for “feedback in practice” that contributes to transformative learning.

Creativity: This skill represents the ability to transcend traditional ideas, rules, patterns, relationships or interpretations by creating and imagining original new ideas, forms or methods, and to integrate new technologies in the process. Many of the constructivist tools that support creativity also support content creation. Being able to use technology in creative ways also fosters the strong relationship between an individual's creativity skills and a sense of confidence. Creativity in PTD aims to move children from being passive users of technology and technological tools to engaging them in productive processes.

Choices of Conduct: Children's responsible use of technology has a significant impact on the development of a sense of character. The most important point is that the child has the opportunity to make behavioral choices, to evaluate possible outcomes in the face of “what if” situations, to have the freedom to choose, and thus to build their own moral compass (Bers, MU, Strawhacker, & Vizner, 2018).

Communication: It is the process of transforming thoughts, opinions or information through interactions using technologies. When mechanisms are formed in a form that supports communication, it is possible to envision ways of using technology to connect with others. Today, new technologically rich developments that encourage new ways of communicating are widespread. New developments in the technologically rich world encourage new ways of communicating. Bers, MU, Strawhacker, A. and Vizner, M. (2018)

Cooperation: It is the chance to voluntarily cooperate with others on a common project. There is a strong reciprocal relationship between children's cooperative behavior and interest in learning environments. In order to collaborate, children need to consider each other's ideas and needs. The more children are encouraged to create and maintain positive bonds and relationships, the more their ability to collaborate improves. Many technologies that support collaboration in learning environments also provide opportunities for people to relate and communicate with each other.

Community building: Community building is an active stance and attitude towards using technology to support and improve the quality of the communication processes of the group and its individuals. There is a strong correlation between active participation in community-building activities and an orientation towards contributing to society by inventing and using new digital tools to solve problems they may encounter in the social environment. Community includes not only the child's interactions with peers, teachers and other staff at school, but also with stakeholders such as family and other members of society.

According to Chau (2014), technology is not a phenomenon in itself, but a construct that has its own environmental and ecological structure and includes a socio-cultural context. The third important part of Bers' PBL framework is the context of the practice. Here, context is directly related to the social parameters and specific characteristics of the environment in which technological interventions are deployed. The context in which the implementation takes place also includes enriching elements such as teacher guidance or peer collaboration, which are complementary elements of technological intervention. These elements can be supportive, but they can also lead to some inhibiting effects on the basis of context. From this point of view, Bers' framework emphasizes the design features of technology to promote the development of skills required by the digital age in children, while placing a strong emphasis on the context of technology use.

PTG is more than just a program or approach; it provides an important framework for planning technology-supported educational processes. It is seen as a framework that ensures technology-supported educational applications for children are developmentally appropriate and serve the purpose of helping children develop positive behaviors. Bers, Strawhacker and Vizner (2018) developed educational applications that build on the ideas of PTD's basic educational framework and interior design principles to develop the design principles of several successful makerspaces. Bers and Kazakoff (2013) examined technology within the PTG framework with a focus on its positive aspects and noted that this framework supports positive behaviors. In programs designed for children to support coding and computational thinking, it has been observed that, in addition to supporting these skills, the PTG framework is used to support positive behaviors (Bers, et al., 2023; Bers, et al., 2019; Elkin, et al., 2016; Metin, et al. 2024; Metin, 2022).

Conclusion

In the 21st century, with the acceleration of technological developments and their support for educational processes, there has been an increased emphasis on helping children develop positive behaviors. The skills highlighted by the PTG (Positive Technological Development) approach, such as creativity, collaboration, communication, content creation, behavior selection, and community building, are now considered essential competencies for all individuals in today's world. In Turkey, these skills are emphasized and supported, particularly in Early Childhood Education (ECE) and the Maarif Model. The concepts of content creation and community building, in particular, are among the fundamental pillars of new preschool education programs.

As a limitation, while the PTG framework primarily focuses on six skills, it can be supported by different skills to make technology-supported education processes more effective. At this point, teachers need to be supported and guided on how to reflect these skills in technology-supported education processes. In addition to the skills teachers are already familiar with, it is important to strengthen their abilities in areas such as behavior selection, community building, and content creation. In educational programs and applications developed in line with the PTG framework, the contributions of this approach must be clearly demonstrated.

Access to technology, teachers' proficiency with technology for teaching, and their capacity to adjust to many cultural contexts are all necessary for the successful application of the Positive Technological Development (PTG) strategy. Technology access issues, particularly in low-socioeconomic areas, can hinder children's development of PTG-based abilities including content production, community building, and creative expression. The depth and caliber of the learning experiences that PTG aims to provide can also be diminished by teachers' inexperience with digital tools. Furthermore, it's important to remember that cultural adaptation is necessary because different cultures may have different ideas about what collaboration, creativity, and content production entail and how important they are. Therefore, it is essential to support teachers through ongoing professional development programs, develop strategies to equalize access to technology, and take into account local values, language, and learning habits when implementing the PTG approach in various socio-cultural contexts.

In conclusion, the PTD framework offers a comprehensive approach to integrating technology into educational settings, aiming to support the holistic development of children. The framework emphasizes utilizing technology not only as a tool to develop cognitive skills, but also as a tool to promote emotional, social and ethical development. Promoting creativity, critical thinking and positive social interactions, PTD offers a balanced perspective on the role of technology in education, addressing both its potential benefits and inherent risks.

The theoretical insights presented in this study underscore the need for educators to take a proactive and thoughtful approach to designing and implementing technology-rich learning environments. Teachers play a crucial role in this process, as their attitudes and practices significantly influence the effectiveness of technology in supporting positive developmental outcomes. Furthermore, the PTD framework encourages the development of digital experiences that are aligned with children's developmental needs, ensuring that the use of technology is both meaningful and enriching. This

approach advocates a shift from viewing technology as merely an educational tool to recognizing it as a crucial element in shaping the future of learning and development.

Ultimately, the integration of the PTD framework into educational practices is intended to create environments that nurture and support children's ability to develop intellectually, emotionally and socially, and to use technology purposefully and productively, rather than as consumers of technology. As technology continues to evolve, it is imperative that educators, researchers and policy makers collaborate to refine and expand the PTD approach and ensure that the benefits of technological advances are fully utilized to promote the positive development of future generations.

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