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Investigation of cognitive and metacognitive strategies used by preservice science teachers exposed to explicit and peer tutoring reading strategies instruction

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Investigation of cognitive and metacognitive strategies used by preservice science teachers exposed to explicit and peer tutoring reading strategies instruction

Gülfem Dilek Yurttaş Kumlu^{1*}, Nejle Yürük² ¹Sinop University ²Gazi University

Abstract

The study aimed to investigate cognitive and metacognitive strategies and products of cognitive and metacognitive processes that preservice science teachers engaged in while reading heat-temperature text after being exposed to no reading strategy instruction, explicit reading strategy instruction, and peer tutoring reading strategy instruction. This study differs from other strategy teaching studies in terms of determining the cognitive and metacognitive reading strategies used by individuals after being exposed to different types of reading strategy instruction, which which was specifically designed to improve conceptual understanding. This study employed holistic multiple-case study wherein preservice teachers were assigned to one of the three groups that received no reading strategy instruction (n = 9), explicit reading strategy instruction (n = 10), and peer tutoring (n = 10) based on their scores on Metacognitive Awareness of Reading Strategies Inventory and good communication among them. The content of strategy instruction included various domain-specific reading comprehension strategies used for activating cognitive and metacognitive processes that contribute to improving conceptual understanding and conceptual change. It was found that the diversity and frequency of using cognitive strategies and products of cognitive strategies and products of cognitive processes were more diverse and frequent in reading strategy instruction groups compared to no strategy instruction group.

Keywords: Cognitive strategies, Metacognitive strategies, Strategy instruction, Conceptual change

Introduction

Some of the leading science educators (Norris & Phillips, 2003; Yore et al., 2004) have emphasized the role of reading science texts in raising scientifically literate individuals (Fang & Wei, 2010). Reading science texts is also supported by contemporary education reforms today. Reading science texts is seen as a powerful instrument to engage students' minds, encourage their conceptual understanding, support their questioning, and improve their scientific mental habits (Wellington & Osborne, 2001). Science text has linguistic and rhetorical features shaped by specific expectations for its genre. These prototypical features specific to the science text genre distinguish a science text from other texts of different genres (Uzun, 2001). Science texts are more objective in comparison to narrative texts, and the intensity of concepts in them is higher. They also include more words and technical terms and understanding them requires more prior knowledge (Jennings et al., 2014). Additionally, science texts contain new information, have special vocabulary, vary in terms of readability level, include abstract concepts, and the reader is expected to keep this information in mind. These properties of science texts can make reading comprehension difficult (Graesser et al., 2002; Vosniadou & Skopeliti, 2017). However, the fact that science texts are different from other text types in terms of language, meaning, and structure makes it difficult for students to understand what they read (McNamara et al., 2012). This is because reading comprehension is a complex cognitive skill that results in the reader's incorporation of information in the text into their prior knowledge and the explanation of a mental representation (Meneghetti et al., 2006). Reading comprehension is an active and

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complicated process that consists of (a) understanding the text, (b) organizing, improving, and interpreting meaningful connections from the text, and (c) using constructed meaning as appropriate to the type of text, purpose, and one's prior knowledge (Kintsch, 2013; National Assessment Governing Board [NAGB], 2012). To overcome difficulties in reading comprehension, various cognitive and metacognitive strategies need to be used (Djudin, 2017). Unfortunately, individuals are often unable to effectively use strategies (Blasiman et al., 2017; Glogger et al., 2012) and they have difficulty in changing their alternative conceptions with scientific conceptions (Dole & Sinatra, 1998). Therefore, there is a need for guidance or training on effective strategy use (Fiorella & Mayer, 2016). Students' awareness of what they know and their conscious use of strategy play a very significant role for academic success (Laskey & Hetzel, 2010; Xu et al., 2021). Additionally, metacognitive engagement while reading science texts supports monitoring and evaluating students' learning, and promotes scientific understanding (Zhang et al., 2015), and it improves students' problem-solving skills (Sandi-Urena et al., 2011). Based on this situation, in this study, it was aimed to teach cognitive and metacognitive reading strategies aimed at activating metaconceptual processes to improve conceptual understanding and eliminate misconceptions. In the teaching of reading strategies, direct instruction and peer instruction were included.

The study was based on social learning theory (Vygotsky, 1978). Teachers provide them with strategy instruction through support and modeling defined as scaffolding to occur learning within the student's zone of proximal development (Ness, 2011). In the present study, explicit reading strategy instruction and peer tutoring reading strategy instructional practices were included, and these practices are based on modeling and peer support methods.

Reading Comprehension, Conceptual Change, and Metacognition

While the reader is trying to understand and learn the concepts during reading, conceptual change occurs from time to time, because the reader's prior knowledge and the information in the text may not always be consistent. The conceptual change also includes becoming aware of the conflict between one's prior knowledge and the scientific explanation, and being able to construct a consistent and compatible conceptual understanding (Luque, 2003). High-level thinking skills need to be used for facilitating conceptual change (Sinatra & Pintrich, 2003). Metacognition, which includes an individual's awareness of one's prior knowledge and one's actively monitoring and regulating of one's cognitive processes (Hennessey, 1999), plays an active role in the individual's awareness of contradiction about scientific concepts and constructing conceptual understanding (Saçkes, 2010).

Metacognitive strategies play a significant role in improving conceptual understanding of scientific ideas (Choi et al., 2011; Nielsen et al., 2009; Wang et al., 2014) and in supporting conceptual change (Mikkilä-Erdmann & Iiskala, 2020). Moreover, metacognition allows students to question the information they have learned, think over the mistakes they have made, and become aware of their misconceptions (Quinn & Wilson, 1997). It can be said that the conceptual change process requires a learner to have metacognitive strategy knowledge and use metacognitive strategies to acquire metaconceptual awareness (Mikkilä-Erdmann & Iiskala, 2020). Conceptual change and metacognition research traditions have mostly developed separately, often without close interaction with each other (Mikkilä-Erdmann & Iiskala, 2020). Therefore, this study addresses cognitive and metacognitive reading strategies aimed at activating metaconceptual processes to improve conceptual understanding and eliminating misconceptions.

Reading in Science Education and Cognitive and Metacognitive Reading Strategies

Reading comprehension is a complex cognitive skill that results in the reader's incorporation of information in the text into their prior knowledge and explanation of a mental representation (Meneghetti et al., 2006). To comprehend science texts and interpret meaning, it is necessary to use various cognitive and metacognitive strategies (Djudin, 2017; Pilten, 2016) and be cognitively and metacognitively active while reading the texts (Yurttaş-Kumlu, 2016). Reading comprehension of science texts, especially finding, selecting, reading, monitoring, and evaluating various information sources, depends on readers' use of a variety of cognitive and metacognitive strategies (Djudin, 2017; Norris & Phillips, 2003; Wang et al., 2014; Yore, 2012).

Based on the purpose of using strategies, reading strategies can be classified into cognitive and metacognitive strategies. While cognitive strategies are needed to perform a task, metacognitive strategies are needed to understand how the task is performed (Garner, 1987). Cognitive strategies are rather important in terms of actively using mental processes to better understand the content of the text (Ahmadi et al., 2013) and learn and remember concepts (Leutwyler, 2009; Zohar & David, 2009). Metacognitive strategies are used to become aware of one's

mental processes, monitor and evaluate them (Flavell, 1979; Gunstone & Mitchell, 1998), and ensure one's preregulation, direct one's attention, and selective attention and self-management while performing a task (O'Malley & Chamot, 1990; Vandergrift, 1997). Products of cognitive and metacognitive processes can be defined as verbal expressions or behaviors that are signs of cognitive–metaconceptual processes performed while reading the texts (Yurttaş-Kumlu, 2016). We cannot clearly observe the cognitive or metacognitive process but we can infer from behavior in which the individual displays that one has performed a cognitive or metacognitive processes in this study.

As the term metacognition covers a wide range of mental processes, the term metaconceptual has been used to focus on metacognitive processes that are specific to concept learning (Mason & Boscolo, 2000; Wiser & Amin, 2001; Yürük, 2005). Specifically, metacognitive knowledge and processes that become active in the process of the conceptual change have been defined as the *metaconceptual knowledge* and *metaconceptual processes*, and these metaconceptual knowledge and processes have been classified as metaconceptual knowledge, awareness, monitoring, and evaluation (Yürük et al., 2009). This study focused on strategies and products of processes to activate metaconceptual processes.

Teaching Reading Strategies

Most of the challenges confronted in reading comprehension of science texts can be overcome with reciprocal teaching strategies, such as teacher modeling, peer interaction, and questioning (Pilten, 2016). One of the effective and frequently used methods in reading strategies instruction is explicit reading strategy instruction (Van Keer, 2004). Explicit instruction means that the teacher clearly teaches students about a strategy by explaining and demonstrating how to implement a particular strategy, explaining the benefits of strategy use, and supporting students in strategy implementation. This is called the WWW&H rule for strategy teaching, which stands for What to Do, When, Why, and How (Veenman et al., 2006). This instruction is based on explicit explanations, modeling, and guided practice (Rupley et al., 2009). Through this teaching, teachers help students implement strategies effectively (Veenman, 2011). This instruction is used to effectively teach cognitive (Rupley et al., 2009) and metacognitive strategies (Muteti et al., 2021). Additionally, this instruction can improve students' metacognitive monitoring, learning, transferring, and motivational skills (Zepeda et al., 2015).

Another most popular and well-studied approach to teaching reading strategies is reciprocal instruction. One of the types of this instruction used is peer tutoring (Paris & Hamilton, 2009). All class members are organized in tutor-tutee pairs and these pairs work in collaboration in peer tutoring (Calhoon, 2005). Peer tutoring can be thought of as a dynamic and enjoyable method that encourages participation and offers an alternative way of learning (Alegre-Ansuategui et al., 2018). Peer tutoring makes positive cognitive, metacognitive, affective, and social contributions for the tutor and tutee (Topping, 2005) and improves self-efficacy (Van Keer & Verhaeghe, 2005). Social contributions of peer tutoring are more prominent (Bahar, 2018). Additionally, peer tutoring helps students by explaining how to properly use their metacognitive reading skills and by providing guidance and support in the classroom (Halim et al., 2020). Peer tutoring can be beneficial not only for low achieving or struggling students but also for more successful or gifted students (Love et al., 2021). Moreover, there are studies that show the benefits of peer teaching in teaching metacognitive strategies in literature (Arco-Tirado et al., 2011; De Backer et al., 2012).

Purpose and Importance of the Study

Teachers have limited knowledge of cognitive and metacognitive reading strategies used while reading science texts (Ness, 2016), and they cannot use such learning practices effectively (de Boer, Donker & van der Werf, 2014; Morehead et al., 2015; Wexler et al., 2017). Teachers need support to overcome the problems of integrating reading into science class (Fang & Wei, 2010). In the literature on the instruction of reading strategies, there are studies on identifying the effect of classroom practices on reading, identifying effective reading strategies that increase students' reading comprehension, and determining the effect of teaching of single strategy use on success (Dole et al., 2009). Moreover, students who cannot use reading strategies effectively are less likely to perform conceptual change (Dole & Sinatra, 1998). Considering this problem, it was aimed to examine how preservice science teachers' use of the cognitive and metacognitive reading strategies and products produced following cognitive and metacognitive processes while reading science texts differed in terms of different reading strategies instruction methods in this study. In line with this purpose,

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by comparing the groups who were not exposed to any reading strategies instruction, who were taught with explicit reading strategies, and who were provided with peer tutoring reading strategies instruction, this study sought answers to the following questions:

1. What are the cognitive strategies and products of cognitive processes that preservice teachers engaged in while reading a science text?

2. What are the metacognitive strategies and products of metacognitive processes that preservice teachers engaged in while reading a science text?

How teachers can ensure effective instruction on reading science texts in the best way is an important research topic (Baker et al., 2017). Studies about new and varied strategies and their combinations to achieve students' learning goals are limited, and these kinds of studies are needed (Laskey & Hetzel, 2010). Considering that one of the important problem of science education is students' misconception, there are no studies in the literature on teaching cognitive and metacognitive reading strategies aiming at improving conceptual understanding that have the potential to eliminate misconceptions. This study is important in terms of creating a basic framework related to determining the cognitive and metacognitive reading strategies used by individuals after being exposed to different types of reading strategy instruction designed to teach various types of strategies, which can be especially used to improve conceptual understanding. The findings from this study can provide some insight into the effectiveness of different types of reading strategy instruction in terms of their potential to activate various reading strategies and cognitive and metacognitive processes.

Method

Research Model

In this study, there were three groups that were exposed to three different instructional situations in terms of reading strategies. These three groups were compared in terms of cognitive and metacognitive reading strategies and products of cognitive and metacognitive processes used while engaging in various cognitive and metacognitive processes performed while reading a science text. The case study, which is one of the qualitative research methods, was used and multiple cases were used in this study. These three cases are the groups that did not receive reading strategies instruction, was exposed to explicit strategy instruction, and was exposed to peer tutoring strategy. Each group was considered as a case in this study. Considering the case study research design types in holistic multiple-case studies, each case is examined holistically in itself and then cases are compared with each other (Yıldırım & Şimşek, 2008). A holistic multiple-case study was used as the research method in this study. The design of the research is summarized in Table 1.

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engaged in them while reading				their purposes of being
				engaged in them while reading
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Table 1. Information about the research design of the study

Participants

This study was conducted with 29 voluntary preservice science teachers who were in their third year at the science education department of a university located in Ankara in Turkiye; 11% of the participants are male and 89% of them are female. The GPA of the participants at the university ranged from 2.14 to 3.4. While assigning preservice science teachers to one of the three groups, attention was paid to the fact that the mean scores of each group on Metacognitive Awareness of Reading Strategies Inventory (MARSI) was administered before the instruction. The mean score of all participants from the MARSI scale was calculated as 114 and the standard deviation was 13. Information about the mean score of MARSI scale of groups is presented in Table 2.

Table 2. Mean score of MARSI scale as pretest of groups					
Groups	n	$\overline{X}\overline{X}$			
No reading strategy instruction group	9	111.7			
Explicit reading strategy instruction group	10	113.8			
Peer tutoring reading strategy instruction	10	115.2			
group					

Table 2 shows that the mean scores of each group from the MARSI scale as a pretest were close to each other. Additionally, the maximum diversity of the purposive sampling methods was employed in the formation of the groups. Each group consisted of participants who scored at different levels within themselves, that is, they were heterogeneous. Therefore, in terms of strategy use scores, the groups were heterogeneous in themselves and homogeneous between each other. Besides, convenient sampling was used considering the communication between the participants and the time allocated for the instruction provided for the effectiveness of the instruction.

Data Collection Tools

Metacognitive Awareness of Reading Strategies Inventory Scale

MARSI was developed by Mokhtari and Reichard (2002) and adapted to Turkish by Ozturk (2012), and its reliability coefficient was calculated to be 0.93. The scale was used in this study to form the groups.

Read-aloud and Think-aloud Technique

Read-aloud and think-aloud technique, which requires them to express what they are doing and thinking while performing a task (Yoshida, 2008), enables the readers to identify different cognitive strategies and metacognitive strategies during the process of performing the task (Cromley, 2005). This feature of this technique was implemented in this study to obtain detailed information about the reading strategies used by the participants and the purposes of using them while reading science text. The researcher modeled by reading force-motion and electricity texts to demonstrate how this technique is implemented.

Semistructured Interview Form on the Reading Strategies

It was used to identify the strategies used and products produced—following cognitive and metacognitive processes —as cognitive and metacognitive and determine the purposes of using them while reading a science text. The form developed by Kumlu (2012) consists of nine items. Two of these items are related to preparations before reading the science text. One item is related to investigating the purpose of using each strategy while reading. The strategies used by the participants while reading the text were observed and notes were taken by the researcher. Six items are aimed at identifying the strategies used for mental processes performed for reading comprehension and the text section in which these strategies are used. This interview form was administered after reading in order not to affect the participants' reading process of the science text.

Heat-temperature Text

The four-page text, which was prepared by Akgul (2010), was revised and used in this study. This science text consists of the definitions of concepts, such as heat exchange, heat, temperature, heat and temperature, heat and internal energy, specific heat capacity, and heat insulation, and the scientific knowledge about the relationships between concepts, tables, formulas, symbols, and figures. An expert on science education was consulted to examine the cohesion and scientific quality of this science text written about heat-temperature.

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The aim of using this text was to determine whether the participants used the strategies that are thought to facilitate conceptual change after reading strategies instruction.

The Stages of Strategy Instruction

One of the three groups in this study was not exposed to any reading strategies instruction, and they just read the science texts that are related to force-motion, electricity, photosynthesis-respiration, and the phases of the Moon and discussed the text contents after reading (nine preservice science teachers). The instruction process lasted 5 weeks in the other two groups. It was aimed to teach various general-specific and domain-specific reading strategies used to activate metaconceptual processes in strategy instruction. The teaching of strategies that are thought to contribute to improving conceptual understanding and facilitating conceptual change was also included.

Explicit Strategy Instruction

The following steps of explicit strategy instruction were prepared by considering the studies conducted by Nist and Holschuh (2000). These steps are:

(a) Explaining the definitions of cognitive and metacognitive reading strategies and exemplifying how the y are used. First, the participants were informed about the importance of reading strategies, the reading strategies used while reading science texts, why strategy instruction is needed, which strategy will be effective in what situations, and how the reader can use these strategies to ensure conceptual change (becoming aware of their potential misconceptions and monitoring and evaluating their reading comprehension).

(b) Modeling of reading strategies aimed at activating potential cognitive and metaconceptual processes used while reading a force-motion text and an electricity text by one of the researchers using read-aloud and thinkaloud techniques. The researcher assumed the role of a good reader who has common misconceptions about forcemotion but effectively uses cognitive and metacognitive strategies to improve conceptual understanding and eliminate misconceptions in this step.

(c) Reading a photosynthesis-respiration text with a checklist. The participants were provided a checklist on which they could mark the strategies they used and purposes of using them while reading the photosynthesis-respiration text.

(d) Reading the phases of the Moon text with an evaluation form. This form consists of open-ended questions regarding the strategies they used and purposes of using them while reading.

Peer Tutoring Strategy Instruction

The following steps of peer tutoring strategy instruction were prepared by considering the studies conducted by Palincsar, Brown and Martin (1987) and Al-Hassan (2003). These steps are:

(a) Determining the tutors and tutees. The participants who scored high on the MARSI and correctly answered the concept cartoon on photosynthesis-respiration and phases of the Moon were selected as tutors, and those who scored low on the MARSI and had alternative concepts about photosynthesis-respiration and phases of the Moon were determined as tutees.

(b) Explaining the definitions of cognitive and metacognitive reading strategies and exemplifying how they are used. The first step of explicit strategy instruction was also implemented to preservice teachers who were exposed to peer tutoring reading strategy instruction.

(c) Modeling of reading strategies aimed at activating potential cognitive and metaconceptual processes used while reading a force-motion text by one of the researchers using read-aloud and think-aloud techniques. The implementation in the second step of the explicit strategy instruction was also conducted with a peer tutoring reading strategy instruction group.

(d) Training the tutors. The tutors were first informed about the contribution of this role to themselves and pairs, what to do together with pairs, and what they should pay attention to. The researcher and an expert who assumed

the role of the tutee modeled the reading process together in relation to what kind of role the tutors and tutees would play while reading an electricity text. The tutors and tutees participated in this modeling process separately.

(e) Pairing the tutors and tutees. The pairing was performed by considering the selection criteria for the tutors and tutees and communication between the participants.

(f) Reading photosynthesis-respiration text and the phases of the Moon by pairs. In order for the tutors to perform their role well, they were informed about possible misconceptions about these topics. Additionally, the researchers developed reading scenarios for the texts on photosynthesis-respiration and the phases of the Moon because asking questions by peer tutors during the monitoring and correction of errors by the guides is a challenging role (Thurston et al., 2021). These scenarios prepared tutors to perform this role effectively, contained detailed information about questioning in which part of the text the tutee has misconceptions while reading the text, and if any, encouraging and guiding the use of strategy. The researchers discussed the implementation of the scenarios with the tutors. The tutor and tutee read both science texts in pairs.

In the study, while preparing these texts, attention was paid to the cohesion of texts. Besides, the researchers paid attention to the fact that these texts contain elements, such as figures, graphs, definitions, and formulas, that allow the use of different strategies. Moreover, different experts on science education were consulted to examine the cohesion of text and scientific quality of these written texts. At least two experts gave their opinions for each science text. A professor who works in the area of physics education and an associate professor who works in the area of science education for the force-motion text; a professor who works in the area of physics education and three experts (an associate professor and two assistant professors) who work in the area of biology education and three experts (an associate professor and two assistant professors) who work in the area of science education for the photosynthesis-respiration text; two experts (an associate professor and an assistant professor) who work in the area of science education and a professor who works in the area of science education and a professor who works in the area of astrophysics for the phases of the Moon text; and two experts (a professor and an assistant professor) who work in the area of physics education and two experts (an associate professor and an assistant professor) who work in the area of physics education and two experts (an associate professor and an assistant professor) who work in the area of science education for the photosynthesis-respiration text; two experts (an associate professor and an assistant professor) who work in the area of physics education and two experts (an associate professor and an assistant professor) who work in the area of physics education and two experts (an associate professor and an assistant professor) who work in the area of physics education and two experts (an associate professor and an assistant professor) who work in the area of science education for the Moon text; and two experts (a profes

Data Analysis

Content analysis was conducted to determine in detail the strategies and products of processes used by the participants and purposes of using them while reading the heat-temperature text. While the preservice teachers were reading the science text, video recordings were taken. These recordings were transcribed and analyzed. The steps followed while analyzing the cognitive and metacognitive strategies used and purposes of using them are as follows:

- While each participant was reading a science text, one of the researchers observed each participant and they took notes of verbal expressions or behaviors. After the reading, the researcher asked the participant questions about why they used each expression or behavior.
- The strategies used while reading were labeled. Additionally, the verbal expressions or behaviors of the participants that displayed their cognitive and metacognitive processes while reading the texts were also observed, and these were defined as products of processes.
- To code the strategies and products of processes as cognitive and metacognitive, participants' explanations about the purposes of using each strategy/product of process were examined. If the participant expressed that one used the strategy to learn, remember, and understand the concepts, the strategy was coded as cognitive (Leutwyler, 2009; Zohar & David, 2009). If a participant stated that they used the strategy to become aware of their mental processes, monitor and evaluate them (Flavell, 1979; Gunstone & Mitchell, 1998), and ensure their preregulation, directing their attention, and selective attention and self-management, it was categorized as metacognitive (O'Malley & Chamot, 1990; Vandergrift, 1997). For instance, if a participant stated that they used the strategy to make the information in the text more understandable, understand an idea in the text, activate their prior knowledge, and remember, it was classified as cognitive. If a participant stated that they used the strategy to keep in mind the information in the text, monitor understanding an idea in the text, monitor the consistency of their prior knowledge with information in the text, evaluate, draw attention, and become aware of, it was categorized as metacognitive.
- For the reliability of the observations, one participant who employed various strategies was selected first. The strategies s/he used, products they produced following cognitive and metacognitive processes, and purposes

of using them were coded together with an expert who studied the cognitive and metacognitive strategies by examining the transcripted data.

- When the researcher and expert disagreed on coding, they watched the video recordings of the preservice teachers' reading process again; the literature was then reviewed and a common consensus was reached.
- The answers provided by the participants to the questions in the semistructured interview on the reading strategies regarding the use of special strategies were examined. By comparing the data obtained from this interview form with the observation data and participant's verbal expressions or behaviors, the researchers decided on the purpose of the strategies used by preservice teachers.
- Based on this coding, a table was created about the conditions and the way to use these strategies/products of processes. The strategies and products of processes that are not available in the literature were defined by considering the participant's purpose of the strategy and how it was used. The strategies and products of cognitive and metacognitive processes that other participants engaged in and purposes of using them were also coded based on this table.
- The purpose is related to performing mental processes, such as cognitive or metacognitive process. In fact, the purpose of using strategy can be operationally defined as using the strategy to perform the cognitive or metacognitive process. The cognitive and metacognitive processes obtained in this study are shown in Figure 1.



Figure 1. Processes performed while reading a science text

In Figure 1, it is seen that while reading the science text, the participants performed cognitive and metacognitive processes. The groups performed six different metacognitive processes and these submetacognitive processes are presented in Figure 2.



Figure 2. Submetacognitive processes performed while reading a science text

It is seen that among the metacognitive processes presented in Figure 2, the process of drawing attention has the most variety.

The coding example for determining the strategies and products of cognitive and metacognitive processes that the participant (P6) in the peer tutoring strategy instruction group used and the purposes of engaging in them while reading the text section about the temperature concept are presented in Table 3.

	strategies and the prode	iets produced used and the	purposes of using them	
Text section	Participant's	Strategies and products	Purpose of engaging in	CS/MS
	expressions related to	of processes that the	strategies and products	PCP/P
	their purpose of	participants engage in	of processes	MP
	engaging in strategies			
	and products of			
	processes			
The faster its	Because it seemed	Verbally expressing	To evaluate the	MPP
molecules vibrate, the	reasonable.	the	accuracy/plausibility	
higher temperature of		accuracy/plausibility	of the information in	
the matter and the		of the concepts. Very	the text	
slower it vibrates the		plausible	the text	
lower temperature of		Highlighting	To draw attention to	MS
the motter		Ingingining	the	MB
the matter			the	
			accuracy/plausibility	
			of the information in	
			the text	

Table 3. The strategies and the products produced used and the purposes of using them

*CS: Cognitive Strategy; MS: Metacognitive Strategy; PCP: Products of Cognitive Processes; PMP: Products of Metacognitive Processes

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In Table 3, it is seen that after reading the text, P6 explained the reason for following such a path as "because it seemed reasonable" in this section of the text in the interview. The participant's explanations about the reason for using strategies and products of processes were placed in the column of "the participant's expressions related to their purpose of engaging in strategies and products of processes" of the table. P6 first engaged in the product of the process of "verbally expressing the accuracy/plausibility of the concepts" and then the strategy of highlighting. If the participant did not use any strategies to perform their cognitive and metacognitive processes while reading the text but expressed it verbally, such statements were coded as products of processes. The terms of these strategies and products of processes were provided in the column of "The strategies and products of processes that the participant engage in" of the table. A common and general purpose statement was defined for similar explanations as to why participants engaged in the strategies and products of processes. It is understood that P6 evaluated the plausibility of the information she encountered from the purpose of engaging in the product of the metacognitive process. Thus, the purpose of engaging in this product of metacognitive process was labeled "to evaluate the accuracy/plausibility of the information in the text" and placed in "the purpose of engaging in strategies and products of processes" column. P6 also highlighted this text section with a highlighter, so it can be inferred that they drew attention to this evaluation. The purpose of using this strategy was coded as 'to draw attention to the accuracy/plausibility of the information in the text." Whether the strategy and product of the process used were cognitive or metacognitive was decided according to their purposes of engaging in them and coded accordingly. The product of process and strategy in this sample coding were categorized as metacognitive because they were aimed at activating evaluating and drawing attention.

We referred to the purposes of using the strategies/products of processes as cognitive and metacognitive processes performed in the findings section.

Validity and Reliability of the Study and Ethical Aspects

For the validity and reliability of the study, data triangulation, appropriate and adequate engagement in data collection processes, audit trail, and rich and thick description techniques (Merriam & Tisdell, 2016) were used. In data triangulation, read-aloud and think-aloud techniques were used. One of the researchers observed the strategies and products of processes that each participant engaged in while reading aloud and thinking aloud the relevant text and the researcher took notes. After reading the text, each participant was interviewed. The consistencies of the observation using read-aloud and think-aloud techniques and interview data were examined. Appropriate and adequate participation in data collection processes was provided with the number of participants and length of instruction (5 weeks). The audit trail technique, which is related to the data collection process and coding (Merriam & Tisdell, 2016), is detailed in the data collection tools and data analyses sections. Furthermore, a rich and thick dataset consisting of a 75-page document related to the table that includes the strategy/product of the process, cognitive/metacognitive, and the purpose of engaging in them was obtained. Additionally, the data obtained regarding the terms of the strategies and products of processes engaged in by three participants, their purposes of engaging in them, and whether they were cognitive or metacognitive were coded by the researchers and an expert. The intercoder consistency was found to be 79%. The coders compromised on the inconsistent codes by discussing them with another expert on conceptual understanding and reading strategies.

With regard to ethics, the names of the voluntary preservice science teachers who participated in the study were kept confidential for ethical purposes. In the coding and reporting of the data, the participants were labeled by giving the initial letter of the group they were in and a number.

Results and Discussion

Each group engaged in various cognitive strategies and products of cognitive processes to perform various cognitive processes. The frequency of using these cognitive strategies and products of cognitive processes are presented in Graphic 1.

When Graphic 1 is examined, it is seen that the variety of the strategies used to understand an idea and make the complicated information in the text more understandable was quite high compared to other cognitive processes. It is seen that the frequency of using cognitive strategy was higher in the groups which were exposed to strategy instruction—especially the explicit strategy instruction group.



*It shows that it is a cognitive process product.

Graphic 1. Frequency of using cognitive strategies and products of cognitive processes to perform cognitive processes

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When Graphic 1 is examined in terms of the variety of cognitive strategies and products of cognitive processes, it is seen that the variety of strategies and products of cognitive processes used to understand an idea by the explicit strategy instruction group was higher than the other groups. The variety of strategies and products of cognitive processes used to make the complicated information in the text more understandable was also higher in strategy instruction groups. In general, it is seen that the variety of cognitive strategies and products of cognitive processes used to perform five different cognitive processes was higher in reading strategies instruction groups compared to no strategy instruction group.

Examples from interview data on various cognitive strategies and products of cognitive processes used in these text sections are presented in Table 4.

		in these text section	ions
Kinds of	Strategies and	Text section where	Examples from interview data
cognitive	products of	strategies and products	
process	cognitive	of cognitive processes	
	processes	were engaged in	
	engaged in		
Establishing	Note-taking	Substances with	R: After reading the text section, you wrote
relationships		higher specific heat	Specific heat \uparrow transfer speed \downarrow . Why?
between		have a lower heat	N6: To understand the relationship between the
concepts		transfer speed.	concepts.
Make the	Note-taking	Substances in the same	R: After reading the text section, you wrote
complicated		environment for a long	Different substances in the same environment
information in		time are at the same	are at the same temperature on the text. Why?
the text		temperature, even if	E8: Just to summarize.
understandable		they differ in size and	
		the materials from	
		which they are made.	
Understanding	Inferring	For example, the	R: After reading the text section, you said In
an idea in the		temperatures of tables	other words, the temperatures of two
text		made of the same	substances made of the same material with
		material of different	different masses are equal, here, the
		sizes that have been in	temperature does not depend on mass. Why?
		the same room for a	P4: To understand better.
		long time are equal to	
		each other.	

Table 4. Examples from interview data on various cognitive strategies and products of cognitive processes used

Findings of the metacognitive strategies used to perform metacognitive processes by each group are presented in Graphic 2.

When Graphic 2 is examined, it is seen that the variety of the strategies and products of metacognitive processes used for monitoring ideas was quite high compared to other metacognitive processes. This is followed by becoming aware of not having understood/important/new information, monitoring the consistency of information provided by different sources, evaluating, drawing attention, and facilitation of memorization process. When each metacognitive process is examined, the variety of the metacognitive strategy used to perform drawing attention processes was higher in the group without strategy instruction groups and the peer tutoring strategy instruction group. The frequency of using strategies and products of metacognitive processes strategy used to perform drawing attention metacognitive processes was higher in the strategy instruction groups that were exposed to strategy instruction—especially in the peer tutoring strategy instruction group—compared to the group without strategy instruction.

The variety of metacognitive strategies and products of metacognitive processes used to perform becoming aware of not having understood/important/new information was equal in the three groups. The frequency of using metacognitive strategies and products of metacognitive processes used to perform becoming aware of not having understood/important/new information was higher in the strategy instruction groups compared to no strategy instruction group.





Graphic 2. Frequency of using metacognitive strategies and products of metacognitive processes

It is seen that the variety and the frequency of using strategies and products of metacognitive processes to perform monitoring ideas processes were higher in the reading strategies instruction groups—especially in the peer tutoring strategy instruction group—compared to no strategy instruction group. The variety of metacognitive strategies and products of metacognitive processes used to perform monitoring the consistency of information provided by

different sources was equal in the three groups. The frequency of using metacognitive strategies and products of metacognitive processes to perform the process of monitoring the consistency of information provided by different sources was higher in the strategy instruction groups. It is also seen that the variety of metacognitive strategies used to perform the process of facilitation of memorization was higher in the peer tutoring strategy instruction group. The frequency of using the metacognitive strategies of the explicit strategy instruction group to perform the process of facilitation of memorization was quite high compared to the other groups.

The variety of metacognitive strategies and products of metacognitive processes used to perform evaluating processes were notable in both strategy instruction groups. It is seen that the frequency of using the metacognitive strategies and products of metacognitive processes was higher in the strategy instruction groups—especially in the peer tutoring strategy instruction group.

Examples from interview data on various metacognitive strategies used in these text sections to perform the kinds of metacognitive processes are presented in Table 5.

Kinds of metacognitive process	Strategies and products of metacognitive processes engaged in	Text section where strategies and products of metacognitive processes were engaged in	Examples from interview data
Drawing attention to inaccurate/impla usible knowledge	Underlying	Heat is energy transfer between two objects in contact to reach thermal equilibrium due to the difference in their average kinetic energies.	R: After you read this text section, you underlined it. Why? N3: I underlined it because it was silly.
Drawing attention to knowledge that has changed in their mind	Highlighting Note-taking	In other words, to keep our food warm or to keep our coke cold, it will be sufficient to insulate the container with <i>woolen fabrics</i> that are heat insulators.	R: After reading the text section, you highlighted it and wrote <i>warm and cold</i> . Why? E7: To forget my previous knowledge.
Drawing attention to knowledge that one has their misconception	Highlighting	Since heat is not property owned, we cannot define the energy of hot and cold objects as heat.	R: After reading the text section, you highlighted. Why? P6: I became aware of my misconception, I highlighted it because I had a misconception. I knew that it had heat
Drawing attention to the difference between their prior knowledge and new information provided in the text	Highlighting	For example, iron and wood that are in the same environment for a long time are at the same temperatures.	R: After reading the text section, you said <i>Ooh, we always said</i> <i>they were different</i> . Why? E1: I knew it differently. I did not know like that. It is different from what I know, so I highlighted it.
Becoming aware of not having understood the text after reading	Rereading	Heat is energy transfer between two objects in contact to reach thermal equilibrium due to the difference in their average kinetic energies.	R: After reading the text section, you read it again. Then, you asked So, does it say that if there is no object in contact, there is no heat? Why? N3: I usually read it again if I do not understand something, and I understand it somehow with my own interpretations and my own knowledge.

Table 5. Examples from interview data on various metacognitive strategies and products of metacognitive processes used in these text sections

Table 5. (Continue	(a)		
Kinds of metacognitive process	Strategies and products of metacognitive processes engaged in	lext section where strategies and products of metacognitive processes were engaged in	Examples from interview data
Becoming aware of important information in the text	Rereading Interpreting	Air space in the matter prevents the transmission of heat through vibration. For example, the benefit of using two blankets is to prevent heat transmission with the help of an air layer between them.	R: After reading the text section, you read it again from the phrase <i>air space in the matter</i> and said <i>What's up with the air, it's</i> <i>blocking it.</i> Why? E5: Because it is even more important.
Monitoring the changes in ideas	Interpreting	In other words, to keep our food warm or to keep our coke cold, it will be sufficient to insulate the container with <i>woolen fabrics</i> that are heat insulators.	R: After reading the text section, you said <i>We could use wool not</i> only to keep warm but also to keep it cold. Why? E7: We associate woolen fabrics with the winter. When I think of wool, I always think of warmth, we can even use it for cold.
Monitoring understanding of the content of a text section about which one has noticed their misconception	Inferring Rereading	Since heat is not property owned, we cannot define the energy of hot and cold objects as heat.	 R: After reading the text section, you said <i>Then, heat is transmitted, the temperature is not</i> and reread it. Why? P6: I became aware of my misconception; I knew that it had heat.
Monitoring the inaccuracy of their prior knowledge	*Verbally expressing the accuracy/inaccu racy of their prior knowledge	In this respect, there can be no definition of the amount of heat contained in an object.	R: After reading the text section, you reread it and said <i>I knew it as</i> <i>the amount of heat; what I knew is</i> <i>wrong</i> . Why? E7: A question mark arose in my mind. I underlined that what I knew was wrong, so that my misconception would be corrected.
Facilitation of M memorization v d	Note-taking using visualization by drawing	For example, the temperatures of tables made of the same material of different sizes that have been in the same room for a long time are equal to each other.	R: After reading the text section, you drew two boxes \Box , wrote the table in the boxes, \rightarrow their temperatures are equal. Why? P7: So that it could remain in my mind.
Monitoring * the e consistency of c the in information p provided in the text	Verbally expressing the consistency of the nformation provided in the text	There is a reciprocal relationship in the definition of heat: if two objects are at the same temperature, even if they interact with each other, there is no heat transfer between them.	R: After reading the text section, you said <i>it was mentioned on the previous page</i> . Why? E10: To establish relationships between the paragraphs in the texts.

Table 5. (Commi	<i>ucu</i>)		
Kinds of metacognitive process	Strategies and products of metacognitive processes engaged in	Text section where strategies and products of metacognitive processes were engaged in	Examples from interview data
Monitoring the consistency of their prior knowledge with new information	Comparing the consistency of their prior knowledge with the text information	Heat is energy transfer between two objects in contact to reach thermal equilibrium due to the difference in their average kinetic energies.	R: After reading the text section, you said I knew that heat is the total kinetic possessed by the molecules of a substance, but here it says average kinetic energy. What is heat actually? Substances in contact want to reach thermal equilibrium, heat is their average kinetic energy they spend on this. Why? P6: A definition is given here; I also had a definition in my mind. I interpreted it using my prior knowledge, and then I compared it with the information in the text.
Monitoring the consistency of their prior experience with new information	*Verbally expressing the difference between new information and their prior experience	For example, iron and wood that are in the same environment for a long time are at the same temperature.	R: After you read the text, you said Whereas I expect the iron to be colder, but they are at the same temperature because they have been in the same environment for a long time. Why?
Evaluating the accuracy/ plausibility of the information in the text	Testing the accuracy/ plausibility of concepts by experiencing	Substances in the same environment for a long time are at the same temperature, even if they differ in size and the materials from which they are made.	N8: I used my prior experiences. R: After reading the text section, you said <i>Pencil and pencil</i> sharpener, they have the same temperature, then do they have different heat? But pencil sharpener is like colder. Why? E10: I used materials to confirm the correctness of the knowledge.
Evaluating the accuracy/ plausibility of the new information	*Verbally expressing the accuracy/ plausibility of the concepts	Heat is energy transfer between two objects in contact to reach thermal equilibrium due to the difference in their average kinetic energies.	R: After reading the text section, you said <i>Does heat necessarily</i> <i>have to be transferred? I think</i> <i>this is a very silly definition.</i> Why? N3: I thought the knowledge was

Table 5. (Continued)

Conclusion

In this study, four conclusions were reached. First, the cognitive and metacognitive strategies and products of cognitive and metacognitive processes used to perform various cognitive and metacognitive processes were found to be various. Since such texts include intense scientific information and elements such as tables, figures, formulas, and symbols, it is necessary to use various reading strategies to comprehend what one reads (Djudin, 2017). It was found that the diversity of metacognitive strategies and products of metacognitive processes used is mostly seen in performing the process of monitoring understanding an idea in the text. This is because individuals need to use different strategies to monitor their comprehension (Pourhosein-Gilakjani & Sabouri, 2016). There are also studies in the literature that show that metacognition improves students' ability to monitor reading comprehension from scientific publications (Michalsky 2013; Wang et al., 2014).

Second, the variety and frequency of using cognitive strategies and products of cognitive processes to perform various cognitive processes were the highest in the explicit strategy instruction group. Cognitive strategies were used in most of the studies (Duffy et al., 1987; Ghavamnia, 2019) in the literature in which explicit strategy instruction was implemented to better understand the text and conceptually understand scientific information (Dole et al., 2009). Therefore, it can be said that explicit strategy instruction is effective in teaching cognitive strategies.

Third, it was determined that the metacognitive strategies and products of metacognitive processes and the purposes of using them were more diverse and frequent in the reading strategies instruction groups compared to the no strategy instruction group. The variety of metacognitive strategies and products of metacognitive processes used to perform the processes of becoming aware of not having understood/important/new information and monitoring the consistency of information provided by different sources by the three groups was close to each other. However, the frequency of using metacognitive strategies and products of metacognitive processes was higher in the strategy instruction groups in comparison to the no strategy instruction group. While the variety of metacognitive strategies and products of metacognitive processes used to facilitate memorization was higher in the peer tutoring strategy instruction group, the frequency of using them was the highest in the explicit strategy instruction group. We can say that only one strategy teaching or two different strategies teaching can be used in the acquisition of the skill of using metacognitive strategies and products of metacognitive processes to perform some metacognitive processes. There are studies in the literature that show that both strategy instructions were effective (Van Keer, 2004). With explicit strategy instruction, strategies are clearly taught to students and students learn how to choose the appropriate strategy (Ortlieb, Norris, & Christi, 2012). Furthermore, this strategy instruction can help students monitor and develop their understanding of the text (Nietfeld & Schraw, 2002). Therefore, it can be said that this instruction is effective in using various metacognitive strategies and products of metacognitive processes. The variety and frequency of using strategies were the highest in the peer tutoring strategy instruction group. It can be said that peer tutoring strategy instruction is effective in strategy use. The reason for this can be explained by the fact that the tutor and tutee have more opportunities to practice the use of reading strategies in the peer tutoring strategy instruction (Spörer et al., 2009). In general, the use of both teachings is required for teaching the use of different strategies for different purposes.

Fourth, when the strategy instruction groups were compared between themselves, it was determined that the metacognitive strategies and products of metacognitive processes were more diverse and frequent in the peer strategy teaching group. De Backer et al. (2012) concluded in their study that the peer tutoring strategy instruction was effective in the use of metacognitive and self-regulation strategies. The variety of metacognitive strategies and products of metacognitive processes used by the peer tutoring strategy instruction group, especially for (a) drawing attention, (b) monitoring ideas, and (c) facilitating memorization was quite high. The frequency of using metacognitive strategies and products of metacognitive processes of this group was also notable in performing the processes of (a) drawing attention (especially highlighting strategy), (b) monitoring ideas (especially interpreting and marking strategy), (c) monitoring the consistency of information provided by different sources (especially comparing the consistency of their prior knowledge with the text information strategy), and (d) evaluating (especially the product of the metacognitive process of verbally expressing the accuracy/plausibility of the concepts and interpreting strategy). The reason why the peer tutoring strategy instruction group used various strategies can be explained as follows: in peer tutoring strategy instruction, students perform the reading process in pairs. The student who is more well-informed in terms of strategy use and text content and assumes the role of the tutor first tries to understand what the tutor has read and uses various strategies to ensure that the tutor's peer also understands what they have read from the science text. Thus, peer tutoring strategy instruction helps to improve the tutor's strategy use and content knowledge. In the process of reading together, the tutor supports and guides the tutor's tutee in the learning process by questioning and explaining (Roscoe & Chi, 2008). After the modeling of reading strategies used, pairs continue to read science texts and then students become independent readers in peer tutoring strategy instruction. In the explicit strategy instruction, conversely, students become independent readers after the modeling process. The stages of the strategy instruction provided within the scope of this study were conducted in the same way. Besides, in peer tutoring strategy instruction, the tutors provide support to the tutees in strategy practice, immediate error correction, pacing, and immediate feedback (Johnson & Zabrucky, 2011). In this process, peer interactions potentially increase the tutees' awareness of their learning (Choi et al., 2005). Additionally, peer interaction can guide and facilitate performing metacognitive processes (Palincsar et al., 1987). When the tutees encounter different perspectives or questions from their peer's explanations, they may try to justify their own knowledge or revise their prior knowledge. When the tutees express the deficiencies in their knowledge, they can actively look for new information to fill in these deficiencies. These verbal interactions are considered to be the most effective way of peer interaction in structuring new information (Palincsar, 1986; Webb, 1989).

Researchers claim that metacognition is a fundamental feature in lifelong learning and science education, and that metacognitive involvement is the key to developing a deeper conceptual understanding of scientific thinking (Choi et al., 2011; Wang et al., 2014). Processes of drawing attention, monitoring ideas, monitoring the consistency of information provided by different sources, and evaluating often performed by peer teaching overlap with the conditions in the conceptual change model proposed by Posner et al. (1982) (Yıldız, 2008). Considering that the effective use of reading strategies is closely related to metacognitive skills (Carrell, 1998), it can be said that the strategies that can activate metaconceptual processes are important in terms of contributing to the students' conceptual change.

Recommendations

This research is limited to a four-page science text containing information about heat-temperature, and to the strategies and products of cognitive and metacognitive processes that 29 preservice science teachers used while reading the text aloud and thinking aloud. Similar studies can be conducted again with science texts containing different content and textual elements. Additionally, there is also a need to conduct the research with students from different education levels, such as elementary and middle school. This study is about determining how the strategies used and the purposes of using them (performing a process) are similar and different according to the strategy instruction method. Besides, considering that conceptual understanding and change are important in science education, studies can be conducted to examine the effect of strategy use on developing conceptual understanding and achieving conceptual change. It may be suggested to conduct studies on how different combinations of cognitive and metacognitive strategies vary according to different strategy instruction and its effect on conceptual understanding.

Practitioners should pay attention to the fact that (a) the group in which they practice strategy instruction is not crowded, (b) the length of the text in reading processes where the reading aloud and think-aloud protocol will be used, and (c) the use of cognitive and metacognitive strategies while modeling the process of reading science texts in strategy instruction. Additionally, while modeling the reading process, the practitioners should show how an individual with all possible alternative concepts related to a science topic uses strategies to eliminate alternative concepts.

Learners can use the strategies they have learned not only while reading a science text but also while studying, learning, listening, or writing new information. Thus, they also contribute to the development of their own self-regulation skills. While the researcher is modeling the reading science texts process in strategy instruction, learners can use items that encourage the use of strategies, such as checklists, so that learners can observe the researcher well. They should realize that it is important for learners to learn from their peers as well, and they should look warmly to cooperation efforts.

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First author performed conceptualization, methodology, formal analysis, investigation, data curation, writingoriginal draft preparation, visualization preparation, project administration. The first author's contribution rate is 50%.

Second author performed conceptualization, methodology, validation, resources, data curation, writing - review & editing preparation, proof-reading. The second author's contribution rate is 50%.

Conflicts of Interest

The authors declare that they have no personal and financial conflict of interest associated with this publication to disclose.

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Ethical Approval

This manuscript was produced from doctoral dissertation of first author. All procedures performed in studies involving human participants were in accordance with the ethical standards and the Helsinki Declaration and its later amendments or comparable ethical standards.

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The influence of teachers' need-support profiles on students' collective engagement in science classes: An observational study based on selfdetermination theory

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The influence of teachers' need-support profiles on students' collective engagement in science classes: An observational study based on selfdetermination theory

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Abstract

This study aims to reveal the need-support profiles of science teachers by using three variables (teachers' autonomy support, involvement, and structure support), as well as the role of the teachers with such profiles in students' collective engagement. Within the scope of the study, first of all, the observation form developed by Reeve, Jang, Carrell, Jeon, and Barch (2004) was adapted into Turkish. Then, 41 science lessons taught by different teachers were observed using the form during a class hour. Descriptive statistics, cluster analysis, and independent samples t-tests were performed using IBM SPSS Statistics 20 to analyze the data. The cluster analysis showed that teachers in most classes (n = 35) were highly need-supportive, while a few teachers (n = 6) were moderately need-supportive. The independent samples t-test analysis demonstrated that the collective engagement of the students in the classrooms where the teachers were highly need-supportive. Students' collective engagement varied according to the teachers' need-supportive profiles. In other words, it can be assumed that teacher behaviors play a crucial role in students' collective engagement.

Keywords: Teachers' autonomy support, Teachers' involvement, Teachers' structure support, Students' collective engagement, Science education.

Introduction

With its key role in academic achievement, motivation, and learning, student engagement is a controversial issue among researchers and educators, as well as politicians (Kahu, 2013; Thijs & Verkuyten, 2009; Xu, Chen & Chen, 2020), and has been increasingly attracting the attention in recent years (e.g., Bond, Buntins, Bedenlier, Zawacki-Richter & Kerres, 2020; Guzey & Li, 2022; Raes et al., 2020, Wekullo, 2019; Zepke, 2018). In the simplest terms, student engagement could be defined as the active and efficient participation of students in routine learning activities in the classroom (Reeve, Cheon & Jang, 2020; Skinner, Kindermann, Connell & Wellborn, 2009).

In this respect, self-determination theory (SDT) suggests a clear relationship between the characteristics of the social environment in which individuals exist and their motivation and engagement in the lesson (Reeve, 2012). Student engagement can be influenced by several factors, including teachers, parents, and peers, concerning their support in a social setting. Among these factors, teachers' support is regarded as one of the most important factors (Lam et al., 2012; Lietaert, Roorda, Laevers, Verschueren & De Fraine, 2015). In this regard, most theorists and educators agree that teacher-created classroom environments could profoundly impact students' academic motivation, engagement, and achievement (Patall et al., 2013). The present study follows SDT's perspective on teachers' motivating or instructional style (Ryan & Deci, 2000; Reeve, Jang, Carrell, Jeon & Barch, 2004). Accordingly, the prominent dimensions of teachers' support can be listed as follows: Teachers' autonomy support for their students, teachers' structure support, and their involvement in the classroom environment. In other words, teachers are expected to *support their students' autonomy* by giving them the freedom to make their own choices, support the *structure* by setting clear rules, and ensure their *involvement* by caring for and paying attention to students (Roorda, Koomen, Spilt & Oort, 2011).

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Indeed, there is empirical evidence that teachers' motivating style is related to students' basic psychological needs, predicting students' engagement (e.g., Jang, Kim & Reeve, 2012; 2016). In SDT, there are three basic psychological needs: autonomy, competence, and relatedness. Autonomy is defined as making choices and acting independently; competence is related to the achievement of the desired result with appropriate responses to tasks, while relatedness refers to the need for mutual respect and interest (Deci & Ryan, 2000; Ryan & Deci, 2020). Students' autonomy needs can be satisfied by the teacher's autonomy support motivating style, relatedness can be satisfied by the teacher's involvement, and competence needs can be satisfied by teachers' structure support (Hornstra, Stroet & Weijers, 2021). For instance, the more teacher involvement (that is, the teacher relates to students, makes time, and expresses love, communicates with the student), the better the feedback will be, and this will increase the participation rate of the students (Valdes, Denner, Dickson & Laursen, 2021; Vollet, Kindermann & Skinner 2017).

However, the predictive power of such teacher behaviors with respect to student engagement clearly differs in various studies. For example, Appleton, Christenson, and Furlong (2008) reported that autonomy support and involvement were directly related to student engagement rather than structure, and that structure and autonomy support, or enabling the involvement accompanied by autonomy support, was associated with higher behavioral engagement. Tucker et al. (2002) found that teacher involvement accounts for student engagement more than other dimensions of teachers' need-support. Jang, Reeve, and Deci (2010), on the other hand, discussed students' individual and collective engagement, which is less common in the literature. Their study considers the teachers' autonomy support and structure support as predictors of the students' collective engagement. They also aimed to examine the extent to which students' collective engagement could be predicted concerning science teachers' autonomy support, involvement, and structure support.

Students' collective engagement

Engagement is the energy and effort students employ within their learning community, which can be observed via cognitive or affective indicators (Bond et al., 2020). Student engagement can be defined as the mental state students experience while learning, representing the intersection of emotion and cognition (Barkley & Major, 2020). The USA National Survey of Student Engagement (NSSE) has designated five elements as indicators of engagement: the level of academic challenge, active and collaborative learning, student-faculty interaction, enriching educational experiences, and supportive campus environment (Coates, 2005).

Research has shown that student engagement is generally considered in four dimensions, cognitive, behavioral, emotional, and agentic engagement (Reeve and Tseng, 2011). Cognitive engagement refers to the amounts and types of strategies used by students (Walker, Greene & Mansell, 2006). With cognitive engagement, students can use deeper and more complex learning strategies rather than superficial strategies (Reeve, 2013; Yuan & Kim, 2018). Behavioral engagement denotes students' engagement in learning activities through intense effort and concentration (Skinner & Belmont, 1993). Emotional engagement implies students' interest and desire to learn, as well as positive and negative emotions such as pleasure, curiosity, anxiety, or boredom (Reeve & Tseng, 2011; Skinner & Belmont, 1993). Finally, agentic engagement is defined as students' constructive contributions to the flow of the education they receive, such as asking questions during the lesson or informing the teacher of their preferences and ideas (Reeve & Tseng, 2011). In other words, agentic engagement is a way through which students can improve their learning, development, and performance (Reeve & Shin, 2020). In a general sense, all these engagements are interrelated in such a way that when one engagement type is high, the others are also likely to be high (e.g., Hıdıroğlu, 2014; Reeve, 2013; Reeve & Tseng, 2011). For example, students with high levels of behavioral engagement may show significant cognitive or emotional engagement (Sinatra, Heddy & Lombardi, 2015).

Students' collective engagement indicates that a class community collectively negotiates discipline-related ideas, terms, and norms (Ryu & Lombardi, 2015). In collective engagement, all aspects of student engagement are handled collectively. Student's behaviors in classrooms where there is collective engagement include those such as exhibiting a pleasant and entertaining attitude towards the lesson, asking questions and discussing, showing active and quick behavior, and acting persistently without giving up in the face of challenges (Reeve, Jang, Carrell, Jeon & Barch, 2004). Reeve et al. (2004) measured students' collective engagement through an observation form. This form combines different aspects of engagement, such as attention, effort, verbal engagement, persistence, and positive attitude (Cents-Boonstra, Lichtwarck-Aschoff, Denessen, Aelterman & Haerens, 2021).

For instance, one of the items on the observation form addresses whether students give up easily by decreasing effort over time or persist by increasing effort over time during the challenge. Another example of item taps is

whether the students are verbally silent or verbally participating by talking, asking questions, or discussing (Reeve et al., 2004). As it is based on a strong theoretical conceptualization of engagement (Wellborn, 1991), it is easy to use to rate student behaviors in the classroom, and it does not rely on student perceptions gathered by self-report measures; this observation form has been preferred to measure student engagement in several studies (e.g., Cents- Boonstra et al., 2021; Jang et al., 2010; Reeve & Jang, 2006), In the present study, teachers' need support is taken into account as an important factor affecting students' collective engagement.

Teachers' need support

The SDT's fundamental psychological needs consist of competence, relatedness, and autonomy (Deci & Ryan, 2000; Ryan & Deci, 2020). It often appears that teachers must adopt a teaching style that supports these three needs. The teachers' need supports comprise teachers' autonomy support, which is related to supporting the students' need for autonomy; teachers' involvement, which refers to supporting the students' need for relatedness; and teachers' structure support, which represents the support provided for the sake of students' need for competence (Hornstra, Stroet & Weijers, 2021).

In science education, students academically benefit when they perceive their teacher as implementing need support (e.g., Beghetto, 2007; Burns, Martin & Collie, 2019; Furtak & Kunter, 2012). Perceived need-supportive teaching has been effective in science education for increasing students' motivation, participation, and achievement in science (Burns, Martin, Collie & Mainhard, 2021; Watt, Bucich & Dacosta, 2019).

Teachers' autonomy support

The first variable related to teachers' support addressed in this study is teachers' autonomy support, a concept that refers to the role that an individual in a position of authority takes others' perspectives, considers their emotions, and provides the opportunity for appropriate choices by minimizing pressure (Zhou, Ma & Deci, 2009). Teachers' autonomy support refers to the perception that an individual's views are supported and approved by a teacher (Li, Gao & Sha, 2020). Put differently, when teachers support autonomy, they pay attention to students' views and offer them options (Li et al., 2020; Patall et al., 2013). In addition, teachers who provide autonomy support are likely to be aware of, nurture, and develop students' interests as well as their needs and preferences by taking their perspectives and offering interesting activities to students by giving them appropriately challenging tasks and emphasizing clear learning goals (Jang et al., 2010; Reeve, 2009). Thus, a teaching style that supports autonomy can satisfy students' basic psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Haerens, Aelterman, Vansteenkiste, Soenens & Van Petegem, 2015).

The benefits of teachers' autonomy support in science classes have also been documented by previous studies. For instance, teacher's autonomy support in science lessons increases students' problem-solving (Boggiano, Flink, Shields, Seelbach & Barrett, 1993; Kocoglu & Kanadlı, 2019) and critical thinking skills (Kocoglu & Kanadlı, 2019). Teachers' autonomy support enables students to make their own choices, make decisions, and take on learning responsibilities in science lessons (Akçil & Oğuz, 2015; Oğuz, 2013). Autonomy support from science teachers is positively related to students' autonomous motivation, self-efficacy, and achievement in science over time (Jungert & Koestner, 2015).

Reeve (2009) listed three conditions for supporting autonomy as follows: (i) adopting the students' perspective; (ii) welcoming students' thoughts, feelings, and behaviors; and (iii) supporting students' motivational development and capacity for autonomous self-regulation. In contrast, when autonomy support is not provided, a controlling authority uses pressure tactics to make students think, feel, or behave in the way the teacher suggests, thereby overrunning students' perspectives and pushing them to behave in certain ways through coercive or attention-taking techniques that include punishments (Reeve, 2009; Zhou et al., 2009). With this controlling authority, the quality of students' engagement in the course also decreases. Consequently, students will end up having a superficial quality engagement by pseudo-engaging in classes, as they may feel that it is risky to resist the academic pressures of highly controlling teachers. The fact that students study only the subjects required by their teachers indicates that this engagement remains limited and superficial (Assor, Kaplan, Kanat-Maymon & Roth, 2005).

Teachers' involvement

Teachers who prioritize involvement spend time with students to establish positive relationships, express their care, and share their needs and feelings (Archambault et al., 2020). Involved teachers can establish close

relationships with students and give them adequate feedback. Through involvement with acts – such as showing students interest and affection, adapting to their needs, and providing emotional support – teachers can also meet the student's needs for relatedness, which is one of the basic psychological needs (Hornstra et al., 2021). If students' needs are met with poor guidance and little involvement, their progress and achievement in schoolwork may become uncertain (Stornes, Bru & Idsoe, 2008). Some studies have reported that the higher the students perceive autonomy and structure support, the higher they perceive teacher involvement (e.g., Hornstra et al., 2021). Teachers' involvement encourages student engagement and is strongly linked to emotional engagement (Hospel & Galand, 2013; Sierens, Vansteenkiste, Goossens, Soenens & Dochy, 2009; Skinner & Belmont, 1993).

Teachers' structure support

The other teacher support variable discussed in this study is the structure that a teacher provides in the classroom. The structure refers to conveying clear expectations for the kind of student behavior by providing clear instructions, comprehensive assistance, and feedback regarding their proficiency (Lietaert et al., 2015; Sierens et al., 2009). The structure created by teachers in the classroom environment is the one in which they communicate with the students clearly and understandably to convey what they expect from them, exhibit behaviors in conformity with what is expected of them, and give them positive feedback (Connell & Wellborn, 1991). Consequently, such a structure will limit students' behavior and ensure its continuation (Sierens et al., 2009). Also, the structure in the classroom environment includes a clear and understandable layout, definite plans and objectives, explicitly stated procedures, and fast-paced tasks. In this manner, students will know better how to achieve goals since the structure provided include helping students participate in a task (Sierens et al., 2009; Skinner & Belmont, 1993).

The relationship between teachers' behaviour and students' collective engagement

Many factors influence student engagement (Van Uden, Ritzen & Pieters, 2014). The factors affecting students' engagement in the course generally include peers, teachers' support, classroom structure, autonomy support, and task characteristics (e.g., Fredricks, Blumenfeld & Paris, 2004; Yuan & Kim, 2018). Students' engagement with the lesson is linked to the teachers' behavior (Tas, 2016), and teacher behavior is central to ensuring engagement (Kuh, Kinzie, Buckley, Bridges & Hayek, 2006; Zepke, Leach & Butler, 2014). Research has shown that the studies in the literature generally support the idea that teacher behavior is positively related to student engagement (e.g., Jang et al., 2010; Kiefer, Alley & Ellerbrock, 2015; Lam et al., 2012; Marks, 2000; Martin & Collie, 2019; Skinner, Furrer, Marchand & Kindermann, 2008; Skinner & Belmont, 1993) as well as those that only deal with the relationship between the teachers' autonomy support from among the types of teachers' support and the engagement of the students to the course (e.g., Jang, Kim & Reeve, 2016; Li et al., 2020; Reeve et al., 2004). For instance, Benlahcene, Awang-Hashim and Kaur (2020) found that teachers' autonomy support was positively associated with classroom engagement in their experimental study with undergraduate students (n = 266) at a large public university in northern Malaysia. In another study, Jang et al. (2010) reported that, in addition to the autonomy support given to the students in years 9-11, structure support accounted for students' collective behavioral engagement. Their results showed that teachers' autonomy support and structure support were positively related to the students' behavioral engagement. Similarly, Ucar and Sungur (2017) examined the relationship between 7th-grade students (n = 744) perceptions of classroom environment, self-efficacy beliefs, and engagement in the science course. The researchers revealed that teachers' providing more autonomy support accounted for students' engagement in the lesson in a positive sense.

In this study: (1) the level of autonomy support, involvement, and structure support provided by teachers will be examined; (2) teachers will be profiled according to the level of exhibiting such teacher behaviors; and (3) it will be investigated whether or not there is a difference between the collective engagements of students in classes concerning different teacher profiles. The structure support, involvement, and autonomy support provided by science teachers in their classrooms and the levels of students' collective engagement were identified through observations. Generally, previous studies have measured these variables given student perceptions (e.g., Hornstra et al., 2021; Stornes et al., 2008). However, one of the limitations of this method is the uncertainty of whether the students gave candid answers. It has been recommended that observations be used to overcome this limitation (Jang et al., 2016). For this reason, the original aspect of this study is that it determines teacher behaviors and student engagement levels by making observations. Class profiles will be identified according to teachers' behaviors (autonomy support, involvement and structure), and the collective engagement levels of students in classes with different profiles will be compared.

Method

Design

This is a cross-sectional quantitative study aiming to compare the collective engagement levels of students in classes with different profiles shaped by teacher behavior. To conduct the study, the researchers decided to focus on science lessons; hitherto, they determined certain classrooms taught by different science teachers in different schools with whom they attended the classes for the study. It attempted to explore the extent of autonomy support, involvement, and structure provided by science teachers while teaching and the extent of students' collective engagement by using a structured observation form.

Sample

The study sample was selected according to the convenience sampling method. The participants comprised 41 science teachers in nine middle schools located in one of the largest provinces in eastern Turkey and 1018 middle school students. Of all the teachers, 27 were female, while 14 were male. Approximately 59% of the teachers were science teachers; 17% were physics, chemistry, or biology teachers; 17% of all the teachers had graduated from the physics, chemistry, or biology departments of science faculties; 5% from integrated physics-chemistry-biology teachers, and 2% from institutes of education. Teachers' professional experience ranged from 1 to 35 years, with an average of 16.10 (SD = 9.18) years, and their weekly teaching hours varied between 12 and 30, with an average of 23.64 (SD = 3.78) hours.

Of all the study participants, 33.8% were in Year 6, 36.4% in Year 7, and 29.8% in Year 8. Sixth graders were in the age range of 11 and 12 years, seventh graders of 12 and 13 years, and eighth graders of 13 and 14 years.

Data collection tool

We used an observation form developed by Reeve, Jang, Carrell, Jeon and Barch (2004). The observation form included four sub-dimensions: teachers' autonomy support (4 items), teachers' involvement (4 items), teachers' structure support (5 items), and students' collective engagement (5 items). Table 1 presents the example items given in the sub-dimensions. With its bipolar style, the observation form includes negative statements (1 point) on the left and positive statements (7 points) on the right. The observation form was adapted into Turkish by the researchers. First translated into Turkish, the form was then assessed by two field experts regarding clarity and cultural appropriateness and arranged in line with the recommendations. Afterward, the form was sent to a language specialist together with its original form so that it would be examined in terms of language suitability, as a result of which the Turkish form was edited and given its final form. The Turkish version of the observation form as a result of classroom observations, the Cronbach's alpha coefficient for the sub-dimensions was calculated as 0.73 for teachers' autonomy support, 0.81 for teachers' involvement, 0.91 for teachers' structure support, and 0.97 for students' collective engagement.

Table 1. Sub-Dimensions of the observation form and sample items									
Teacher's autonomy support	Controlling language • Controlling, coercive • Should, must, have to, got to • Pressuring, rigid, no nonsense	1	2	3	<u>4</u>	5	6	7	Informational languageInformationalFlexibleNot at all controlling
Teacher's involvement	Seems cold, closedBusiness likeDoes not enjoy time with Ss	1	2	3	<u>4</u>	5	6	7	 Seems warm, open Expresses, affection, caring Does enjoys time with Ss
Teacher's structure	Poor leadershipFails to show leadershipNo plans, no goals	1	2	3	<u>4</u>	5	6	7	 Strong leadership Organized, leader, conductor Clear plans, clear goals
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Student's collective engagement	Verbally silentStudents don't talk, ask questions, discuss	1	2	3	<u>4</u>	5	6	7	Verbally participatingStudents do talk, ask questions, discuss

Data collection process

The first and second authors collected the data by observing 41 science teachers and their students for one course hour. The observers observed teachers' autonomy-supportive, involvement, and structure-supportive behaviors and rated them considering illustrative descriptors in the observation sheet. On the other hand, students' collective engagement was rated by looking at the students' percentage displaying each behavior and their expression intensity, as suggested by Reeve et al. (2004). Thus, "a high score on an engagement indicator means that most or almost all of the students expressed the behavior, and when they did express it, they did so intensely" (Reeve et al., 2004, p. 157). In the first part of the process, two researchers were present in the same classroom at different spots and made observations together for 4 course hours. At the end of the observation process, the researchers compared the scores they gave in the observation form and calculated the agreement rate between them. The percentage of agreement between the researchers' scores was calculated using the formula "Reliability = [Number of Agreements / (Number of Agreements + Disagreements)] \times 100" (Miles & Huberman, 1994). The agreement between the observation scores of the two researchers was found to be 78%. After achieving the required agreement percentage, the researchers continued their classroom observations separately. The variables of teachers' autonomy support, involvement and structure support, and the students' collective engagement were formed by taking the mean values of the scores, varying between 1 and 7, as given by the researchers to the items in each sub-dimension.

Data analysis

Descriptive statistics, cluster analysis, and independent samples t-tests were performed using IBM SPSS Statistics 20 to analyze the study's variables. In the descriptive statistics part of the data analysis process, the mean and standard deviation were calculated to determine the level of teachers' autonomy support, involvement, and structure support and students' engagement, whereas cluster analysis was employed to determine the teachers' behavior profiles. An independent samples t-test was used to determine whether or not there is a difference between the collective engagements of students in classes with different teacher profiles.

Results

Descriptive statistics

Descriptive statistics for the variables of the study are presented in Table 2. Compared to 4, the mid-point of the scale, all teacher variables and students' collective engagement have high mean values which ranged from 5.47 to 5.86.

	М	SD	Min-Max	Skewness	Kurtosis
Teacher autonomy support	5.74	.94	3.21-6.94	-1.30	1.07
Teacher involvement	5.72	1.13	2.75-7.00	-1.04	.67
Teacher structure support	5.86	1.02	2.83-7.00	-1.31	1.38
Students' collective engagement	5.47	1.36	2.20-7.00	87	09

Table 2. Descriptive statistics

Cluster analysis

A cluster analysis was conducted to determine the teachers' profiles in the observed science classes. The kmeans cluster method was used by restricting the number of clusters to two, three, and four, respectively. The analysis with two clusters provided the most interpretable results. In the first cluster, teachers' autonomy, involvement, and structure were centered at 6.04, 6.05, and 6.17 points, while in the second cluster, they were centered at 4.00, 3.79, and 4.03 points, respectively. All three variables were found to significantly impact which cluster teachers were grouped into (Table 3). The first cluster (n = 35) involves teachers who have high autonomy support, involvement, and structure support, while the second cluster (n = 6) involves teachers, considering the mid-point (4) of the observation items, with relatively lower autonomy support, involvement, and structure support in science class. Therefore, these 1st and 2nd clusters can be named high supportive and moderate supportive, respectively. Figure 1 shows the levels of variables in each cluster.

Table 3. Cluster centers and F values											
	Cluster centers		F	р							
	Cluster 1	Cluster 2	-								
	High supportive	Moderate supportive									
Autonomy support	6.04	4.00	58.561	.000							
Involvement	6.05	3.79	40.685	.000							
Structure support	6.17	4.03	49.641	.000							



Figure 1. Levels of variables within clusters

Independent samples t-test

After obtaining two teacher profiles within observed classrooms, an independent samples t-test was performed to examine whether students' collective engagement differed depending on the teacher's supportive profile. Since the number of teachers within each cluster is different, the homogeneity of variance assumption was checked, and Levene's test showed that this assumption is not violated (F = 0.13, p = 0.91). Additionally, the normality test indicated the normal distribution of low supportive clusters even though they have a small number of observations (Shapiro-Wilk test statistic = 0.90, p = 0.40). Independent samples t-test showed that students in classes taught by teachers who have highly supportive teaching profiles have statistically significantly higher collaboration ($\overline{X} = 5.82$, SD = 1.07, $t_{(39)} = 5.03$, p < 0.05) than students taught by moderate supportive teachers ($\overline{X} = 3.43$, SD = 1.08). The eta-squared value of 0.39 indicates a large effect size (Cohen, 1988). Table 4 presents the findings of the t-test for students' collective engagement.

Table 4. Results of independent samples t-test for student's collective engagement

	n	x	SD	t	df	р
High supportive profile	35	5.82	1.07	5.02*	20	000*
Low supportive profile	6	3.43	1.08	5.05	39	.000

**p*<.05

Conclusion

This study aimed to reveal the class profiles according to the science teachers' behaviors and to compare the students' collective engagement in science with different teacher profiles. The teacher behaviors addressed in this study included teachers' autonomy support, involvement, and structure support, while students' collective engagements comprised their task engagements and work to influence the flow of classroom activities. Analysis of observation data indicated high levels of teachers' autonomy support, involvement, and structure support. Similarly, the students' collective engagement levels were also high.

According to the cluster analysis performed to specify science teachers' profiles, the appropriate number of clusters turned out to be. Most teachers (approximately 85%) were in the first cluster. The teachers' autonomy, structure support, and involvement seemed high in the first cluster, in which the teachers' profiles were highly supportive. In other words, the important factors that made up this cluster were high autonomy support, structure, and teacher involvement. Approximately 15% of the teachers were in the second cluster. The teacher behaviors in the second cluster seemed to be gathering around the midpoint of the scale, and thus the teachers' profiles in the second cluster were found to be moderately supportive. Therefore, the teachers were found to provide a highly supportive attitude in most of the science classes, while those in the remaining science classes seemed to provide moderate support. Though it should not be forgotten that this may be related to the selected sample, it can still be considered satisfactory because teachers' support plays an important role in both motivation and engagement of students (Fredricks et al., 2004; Kuh et al., 2006; Lam et al., 2012; Lietaert et al., 2015; Rolland, 2012; Tas, 2016). Undoubtedly, in learning environments where students are cared for and given the feeling that their wishes are considered, student interest and engagement in the course are likely to increase (Patall et al., 2018; Tsai, Kunter, Lüdtke, Trautwein, & Ryan, 2008). As regards teachers, such environments seem to increase their self-confidence and enable them to enjoy job satisfaction (Cheon, Reeve, Yu & Jang, 2014). Thus, teachers' sense of control over their behavior increases; the feeling of pressure and strain is minimized (Costa, Soenens, Gugliandolo, Cuzzocrea & Larcan, 2015).

The present study compared the collective engagement levels of students with different science teacher profiles. The results showed that the students' collective engagement was higher in science classrooms, with teachers' showing higher levels of supporting behavior than those with teachers showing moderate level behavior. In other words, students were more likely to focus their attention, display effort, participate verbally, persist during the challenge, and have a positive emotional tone when their teachers were more need-supportive. This finding is in line with the premises of the SDT since it links the characteristics of the learning environment with students' motivation and engagement in the course (Reeve, 2012; Reeve, Deci, & Ryan, 2004). If the social environment meets the psychological needs of individuals, individuals will be able to engage emotionally, behaviorally, and cognitively in their environment (Connell & Wellborn, 1991). Among the factors that stand out in influencing the motivation of individuals in the social environment are the teacher's support for students' autonomy and the structure provided by the teacher in the classroom environment (Connell & Wellborn, 1991). Indeed, "Autonomy support is seen as promoting both autonomy and relatedness satisfaction, and when it occurs along with structure, competence as well." (Ryan & Deci, p. 3).

Autonomy support shown in the classroom environment plays a critical role in students' engagement (Cheon, Reeve & Song, 2016; Cheon, Reeve & Vansteenkiste, 2020; Jang et al., 2016; Lietaert et al., 2015; Reeve, 2013; Reeve & Tseng, 2011; Uçar & Sungur, 2017). In the classrooms where autonomy support is provided, teachers consider students' thoughts, feelings, and behaviors, and in return, students can ask questions freely, share their ideas, and choose activities in line with their interests and wishes. Moreover, with the autonomy support provided by a teacher in the classroom, students are likely to concentrate more, thereby showing more effort to achieve the given task (Jang et al., 2010). Based on our findings, which are compatible with the literature, it could be concluded that the teachers fed the students' internal motivation by giving them enjoyable and challenging tasks, that they used informative language instead of controlling language, and that the collective engagements of the students in the science classes where the teachers recognized and took the students' perspectives and feelings were at a higher level. Teachers who are satisfied with their need for relatedness can establish real and sincere relationships. In classrooms where teachers provide a high level of support, students' motivation and class participation have increased. Teachers with high autonomy support feel useful and

resourceful, thus achieving more satisfaction in their lives and in their work (Reis, Sheldon, Gable, Roscoe & Ryan, 2018).

The teachers' structure support, which is another teacher behavior used in creating the clusters in this study, denotes the idea that teachers should guide their students step by step to become successful in a given task (Vansteenkiste et al., 2012), as well as giving constructive and positive feedback (Carpentier & Mageau, 2016; Mouratidis, Michou, Aelterman, Haerens & Vansteenkiste, 2008). Teachers with such characteristics are likely to increase their student's engagement with the lessons (Cheon et al., 2016; Jang et al., 2016; Reeve, 2013; Reeve & Tseng, 2011; Uçar & Sungur, 2017). As similarly mentioned in the relevant literature, this result shows that students tend to exhibit a higher collective engagement in science classrooms where teachers are clear, predictable, and understandable (clear expression of learning goals) and use informative and constructive feedback in classroom environments where they support students (strong leadership, multi-dimensional support). Teacher involvement, the last teacher behavior examined in this study, is an important predictor of student engagement (Tucker et al., 2002: Vollet et al., 2017). The more positively the teacher interacts with and supports students, the more positive response the students will give (Valdes et al., 2021). Likewise, the more teacher involvement students feel, the greater their engagement in the lesson (Hornstra et al., 2021; Hospel & Galand, 2013; Sierens et al., 2009; Skinner & Belmont, 1993). In our study, we found higher collective engagement of the students in the science classes with teachers who showed their care and compassion and spared enough time for their students.

Given the findings, it can be assumed that teacher behaviors play a crucial role in students' collective engagement. It is noteworthy that there is a statistical significance between the mean collective engagement scores of the students in both groups. The moderately supportive teacher profile indicates that student engagement is low; that is, it is below the mean score of the scale, which is 4. Based on such results, it can thus be concluded that if high student engagement is to be achieved, the teacher profiles should be above moderate. Teachers' structure and autonomy support in the learning environment is regarded as student-centered teaching (Jang et al., 2010; Reeve & Jang, 2006; Sierens et al., 2009). A teacher who adopts such an approach supports the development of students' self-confidence by allowing them to make choices in the lesson. Also, noncontrolling informative language, listening to students, and responding reasonably (autonomy support) help a student feel important. In this way, teachers can help the students to develop their creativity, find original ideas, and come up with solutions. Science teachers who are capable of demonstrating strong leadership during the lesson, supporting their students with tips and reminders, providing a clear and understandable lesson organization, and finally giving instructive and informative feedback (teachers' structure support), and those who can communicate closely with students and make use of their care and energy for their students (teachers' involvement) can help students not only to be more active but also to be more attentive and persistent in their assigned tasks. Teacher involvement helps teachers be energetic, effective, and passionate about their work. In other words, involved teachers can motivate themselves and act effectively and energetically in the given tasks (Klassen et al., 2012). Success, power, and relationships support both functionality and harmony of individuals (Patrick, Knee, Canevello & Lonsbary, 2007).

Recommendations

Structured teaching activities supporting autonomy are an ideal example of motivation that may have important and wide-ranging educational benefits. Teachers who know how to support autonomy and establish structure and practice it in their classrooms will likely foster increased student motivation and engagement. Apart from these, adopting such an approach will help them perform their job devotedly, besides establishing a sound and satisfying relationship with their students (Cheon et al., 2020). In this regard, teachers can be trained to increase their autonomy support, involvement, and structure support. The training content may cover topics such as giving students a chance to choose among different activities, as well as how to be clear and understandable about their expectations from the students. By conducting experimental studies, the impact of such training on student engagement in a course could be examined more. Thus, it would be possible to establish a cause-andeffect relationship between teachers' structure support, involvement, autonomy support, and student engagement. Future studies may focus on discussing students' views on the classroom environment through interviews with students in addition to classroom observations. Furthermore, by interviewing the teachers, it can be attempted to reveal the reasons for displaying their relevant behaviors in the classroom and their views on the effects of such behaviors on their students.

This study designated the science course for its purposes and examined the behaviors of science teachers and the collective engagement of students in science lessons. We believe comparing the results by conducting similar studies in other disciplines will be useful. Finally, the study has some limitations that should be acknowledged.

It should be noted that convenience sampling used for selecting the classes in which the observations were made in this study limited the generalizability of the results. The results obtained from this study are limited to observing 41 science teachers and their students for one course hour. Including more classes may be useful to reveal additional teacher profiles, if any. The only data collection tool was an observation form; interviews with students and teachers can be accompanied for gathering more detailed data. Additionally, no pilot study was conducted before the main study, which is another limitation.

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A short version of this study was presented in International Conference on Research in Education and Science (ICRES) in Kuşadası, in Turkey, in 2017.

Author (s) Contribution Rate

All authors have equal contribution rates

Conflicts of Interest

No potential conflict of interest was reported by the authors.

Ethical Approval

This study was produced with the supports of the Scientific Research Projects (Bilimsel Araştırma Projeleri [BAP]) Coordination Unit of Atatürk University with the code PRJ2016/298 and titled "The Relationship between The Structure Provided by the Science Teacher, Autonomy Support and Participation with Students' Engagement in Science Classes". The study was conducted in 2016-2017 academic year and Ethics Committee Certificate was not requested because it was not mandatory in these years. However, the project was examined in detail by the Atatürk University BAP Coordination Unit and it was deemed appropriate to be implemented and supported.

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Appendix: Turkish version of the observation form

ÖĞRETMEN ÖZERKLİK DESTEĞİ

Dışsal motivasyonel kaynaklara dayanır	1	2	3	<u>4</u>	5	6	7	İçsel motivasyonel kaynaklara dayanır
• Teşvikler, sonuçlar								• İlgi, zevk
Yönergeler-talimatlar, Zaman sınırlamaları								Zorlayıcı görev
• Görevler (ödevler) verme								Yeterlik/ güven
• Uyum arama								Seçim yapma
Kontrol edici dil	1	2	3	<u>4</u>	5	6	7	Resmi olmayan (gündelik) dil
Kontrol altına alan, zorlayan								Bilgilendirici
Gerekli, zorunlu, mecburi								• Esnek
Baskılayıcı, kesin								Kontrol altına almayan
Dersin/görevlerin/davranışların değer ve önemini ihmal	1	2	3	<u>4</u>	5	6	7	Dersin/görevin/davranışların önemini ve değerini
eder								vurgular
• Değer, anlam, kullanış, fayda ve önemini ihmal eder								 Değerini, anlamını, kullanımını, faydalarını ve önemini vurgular "bu önemli, çünkü"
Olumsuz duygulara karşı tepki: Olmadı; değiştir onu	1	2	3	<u>4</u>	5	6	7	Olumsuz duygulara karşı tepki: Tamam; dinler, kabul eder
Olumsuz duygular kabul edilemez								Dikkatlice dinler
 Düzeltmeye, önlemeye veya başka bir şeye dönüştürmeye çalışır 								Şikâyetlere açıktır
								Kabul eder ve tepkiyi makul karşılar

ÖĞRETMEN KATILIMI

Soğuk, mesafeli görünüyor	1	2	3	4	5	6	7	Sıcak, içten görünür
• Ciddi								• Duygularını belli eder, ilgi gösterir
• Öğrencilerle birlikte vakit geçirmekten hoşlanmaz.								Öğrencilerle birlikte vakit geçirmekten hoşlanır
Kişisel kaynaklarını esirger (kısıtlar)	1	2	3	<u>4</u>	5	6	7	Kişisel kaynaklarını kullanır
• Zaman, ilgi, enerji								• Zaman, ilgi, enerji
Fiziksel yakınlık: Uzak	1	2	3	<u>4</u>	5	6	7	Fiziksel yakinlik: Yakın
Mesafeli durur								Öğrencilere doğru yürür

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Öğrencileri bilme durumu: Hayır, bilmez	1	2	3	<u>4</u>	5	6	7	Öğrencileri bilme durumu: Evet, detaylı bilgiye sahiptir
Öğrencilere isimleri ile hitap etmez, öğrencilerin aladamile yaya kişişel geomişlərindən hahaətməz								Öğrencilere isimleri ile hitap eder, öğrencilerin aladamile yaya kişişəl gəamişlərini bilir
akademik veya kişisel geçimşielinden dansetmez								akadennik veya kişisel geçinişlerini onn

ÖĞRETMENİN YAPISI

<u>Girişte / yönlendirme yaparken</u>								
Hiç yok, kafa karıştırıcı, belirsiz, karmaşık	1	2	3	4	5	6	7	Açık, tahmin edilebilir, anlaşılır, detaylı
 Kurallar ve prosedürler karmaşık, yok Çok az ya da hiç düzen yok Hiç yok, kafa karıştırıcı, belirsiz, karmaşık 								 Açıkça belirtilmiş prosedürler Gelecek dersin çerçevesini iyi bir şekilde çizer Açık ve anlaşılır bir düzen
<u>Ders sırasında/ öğrenciler öğrenirken</u>								
Kötü liderlik	1	2	3	<u>4</u>	5	6	7	Güçlü liderlik
Liderlik etmekte başarısızlıkPlan yok, hedef yok								Düzenli lider, kılavuzAçık plan, açık hedefler
Az, kolayiş yükü	1	2	3	<u>4</u>	5	6	7	Çok, zor iş yükü
Az zorlanma, düşük tempoÇok az kapasite kullanmasını gerektiren görev verme								 Çok zorlama, yüksek tempo Çok fazla kapasite kullanmasını gerektiren görev verme
Hiç destek sağlamaz	1	2	3	<u>4</u>	5	6	7	Çok yönlü destek olma
 İpuçları, hatırlatmalar yok Öğrencilerin soruları kaçırıldı, yetersiz cevaplar verildi 								 İpuçları, hatırlatıcılar Sorulara iyi ve tam cevap verir
<u>Geribildirim esnasında, performans sonrası yorumlama</u>	1	2	3	<u>4</u>	5	6	7	
 Yok, belirsiz, konuyla ilgisiz, konudan konuya atlayan 								Beceri kazandıran, bilgilendirici, öğretici

ÖĞRENCİNİN TOPLU (KOLEKTİF) KATILIMI

Dikkat dağınık	1	2	3	4	5	6	7	Odaklanı lmış İlgi
Pasif, yavaş, az çaba	1	2	3	<u>4</u>	5	6	7	Aktif, çabuk, yoğun çaba
Sessizlik	1	2	3	4	5	6	7	Sözel Katılım

Öğrenciler konuşmaz, soru sormaz, tartışmaz								Öğrenciler konuşur, soru sorar, tartışır
<u>Zorlanma, başarısızlık veya kafa karışıklığı sırasında</u>								
Kolayca pes eder	1	2	3	<u>4</u>	5	6	7	Israr eder
Zamanla gösterdikleri çaba azalır								 Zamanla gösterdikleri çaba artar
Tatsız duygu hali	1	2	3	<u>4</u>	5	6	7	Pozitif duygu hali
 Sıkılmış, ilgisiz, tatsız 								 Hoşnut, ilgili, eğlenceli



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The Effect of Mathematical Modelling Activities on Students' Mathematical Modelling Skills in the Context of STEM Education

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The Effect of Mathematical Modelling Activities on Students'

Yaprak Armutcu^{1*}, Ayten Pınar Bal¹ ¹Cukurova University

Mathematical Modelling Skills in the Context of STEM Education

Abstract

This study was conducted to examine the effect of mathematical modelling activities on the mathematical modelling skills of secondary school students in the context of STEM education. The study was designed according to the embedded design, one of the mixed research methods. The study group of research consists of 66 eighth-grade students studying in a public school in the central district of a large province in the south of Turkey in the 2020-2021 academic year. While the criterion sampling method, one of the purposeful sampling methods, was used to determine the quantitative study group of the research, the maximum variation sampling method was used to determine the qualitative study group. On the other hand, in the context of STEM education, mathematical modelling problems, evaluation rubric and semi-structured interview forms were used as data collection tools in the research. As a result of the research; It was concluded that mathematical modelling activities in the context of STEM education positively improved the mathematical modelling skills of secondary school students. In addition, it has been concluded that the students who receive education with mathematical modelling activities applied in the context of STEM education gain different interdisciplinary perspectives, experience positive developments in their thinking skills, adapt to group work more easily, and increase their interest in engineering and technology.

Keywords: STEM education, Mathematical modeling, STEM-based mathematical modeling activities

Introduction

In today's world, it is essential that people who can adapt to technological advances acquire 21st century skills (NSTA, 2011) so that they can grow up more competent and better equipped. From this point of view, STEM education, as a combination of science branches such as science, technology, mathematics and engineering, emerges as an important paradigm for individuals to gain an interdisciplinary perspective in solving the problems they encounter in daily life and to develop their high-level thinking skills. These higher-order thinking skills are mostly referred to as 21st-century skills appear in various waysin different studies and research (Byee, 2010; Wagner, 2008; Windschitl, 2009). According to many researchers, these skills include high-level thinking skills such as critical thinking, estimation, problem-solving, and reasoning and social skills such as cooperation, entrepreneurship, communication, creativity, and innovation (English & Watters, 2004; NCTM, 2020; Partnership for 21st Century Skills, 2015).

From this point of view, one of the main purposes of the mathematics course is to provide students with problemsolving skills (NCTM, 2020; Partnership for 21st Century Skills, 2015; MoNE, 2018). Mathematics also contributes to 21st-century skills as a discipline that has been continuously developed for centuries and is essentially problem-solving (Mevarech & Kramarski, 2003), which has been finding solutions to the various and most interesting problems of humanity for many years. In this context, modelling mathematical modelling is one of the mathematics teaching approaches that helps individuals establish a relationship between mathematics and find different solutions to real life problems (Arleback, Doerr & O'Neil, 2013, Artigue & Blomhøj, 2013; English, 2016). modelling As one of the most important elements enabling the transition to STEM education, mathematical modelling can be defined as expressing and solving a problem encountered in daily life mathematically and adapting the mathematical solution to daily life (Berry & Houston, 1995; Cakiroglu & Dedebas, 2018; Doruk & Umay, 2011; Borromeo Ferri, 2006; Crouch & Haines, 2007; Blum & Leiß, 2007; Kaiser, 2017). Mathematical modelling studies use other branches of science such as science and technology, engineering, and mathematics, in solving daily life problems. In this context, mathematical modelling applications, together with an effective

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STEM education, significantly contribute to students' analytical thinking skills, problem-solving skills, and assimilation of technology-based learning processes (e.g., Cakiroglu & Dedebas, 2018; Doruk & Umay, 2011; Niss, Blum & Galbraith, 2007; Crouch & Haines, 2007; Kaiser, 2017; Lesh & Doerr, 2003; Mason, 1998; English, Hudson & Dawes, 2013; Kertil & Gurel, 2016; Lesh & Zawojewski, 2007).

On the other hand, when the studies on STEM education are examined in the literature, these studies mostly focus on teacher candidates (Bergsten & Frejd, 2019; Yildirim & Altun, 2015; Yildirim & Turk, 2018) and teachers (Weber, 2015; Du Plessis, 2018; Geiger, 2019) competencies and attitudes are examined (Yildirim & Turk, 2018). Studies with students (Atit, Power, Veurink, et al., 2020; Cho & Lee, 2013; Miller, 2019; Rozgonjuk, Kraav, Mikkor, et al., 2020) are mostly about academic success and are generally experimental studies (Bergsten & Frejd, 2019; Yildirim & Turk, 2018). Other areas of study for the STEM approach are scale development and analysis studies (Buyruk, & Korkmaz, 2016). As can be seen from the relevant literature, a limited number of studies examining STEM education and mathematical modelling activities together, generally; these are the opinions of teachers and students about the use of mathematical modelling as a tool in STEM education (Guder & Gurbuz, 2018-English & Mousoulides, 2015) and research on the application of mathematical modelling in STEM education (Bergsten & Frejd, 2019; Derin & Aydın, 2020; English & Mousoulides, 2015). However, within the available literature, no study has been found that examines the effect of mathematical modelling activities on students' mathematical modelling skills in the context of STEM education.

In this context, for example, Derin and Aydin (2020), as a result of their research in which they examined the use of the STEM education approach in teacher education, concluded that the STEM education approach provided significant and positive improvements in the mathematical modelling and problem-solving skills of teacher candidates. Similarly, Bergsten and Frejd (2019) concluded in their study that teacher candidates could successfully design innovative STEM activities using mathematics and mathematical modelling after the training they received for STEM education and twenty-first-century skills. Again, English and Mousoulides (2015) examined the bridge construction processes of sixth-grade students with a STEM-based modelling activity. As a result of the study, they concluded that the students understood the nature of problem-solving, carefully analysed the complex data involved in solving real-life problems, and produced more than one acceptable solution.

A limited number of studies (Bergsten & Frejd, 2019; Derin & Aydin, 2020; English & Mousoulides 2015), in the literature examining STEM education and mathematical modelling activities together. Based on this idea, this study was conducted to examine the effect of mathematical modelling activities on the mathematical modelling skills of secondary school students in the context of STEM education and contributing to the field. For this purpose, answers to the following questions were sought:

1) What are the students' pre-test and post-test problems regarding the results of mathematical modelling problems in the context of STEM education?

2) What are the students' views on the solution process of mathematical modelling problems in the context of STEM education?

Literature Review

Mathematical Modelling

Mathematical modelling can be defined as mathematically expressing a problem encountered in daily life and adapting its solution to daily life (Blum & Leiß, 2007; Quarteroni, 2009; Borromeo Ferri, 2006; Doruk & Umay, 2011; Crouch & Haines, 2007; Kaiser, 2017; Berry & Houston, 1995). According to Blum and Leiß (2007), the modelling process can be expressed as making assumptions by understanding and analyzing the real-world situation in the mathematical world and interpreting the result in the real world. In the mathematical modelling approach, real-world problems usually consist of interdisciplinary problems. However, many researchers have stated that mathematical modelling applications are one of the most important elements in the development of students' analytical thinking skills, problem-solving skills and the qualifications they need in the technology-based information age (e.g. Lesh & Zawojewski, 2007; Niss, et al., 2007).

On the other hand, the competencies required to perform the modelling process largely overlap with twenty-first century skills (Arleback, Doerr & O'Neil, 2013, Artigue & Blomhøj, 2013; English, 2016). In this context, many researchers emphasize that mathematical modelling should be given more place in school mathematics (Blum, Galbraith, Henn & Niss, 2007; Doorman & Gravemeijer, 2009; García & Maass & Wake, 2010; NCTM, 2000). From this point of view, mathematical modelling practices are frequently encountered in classroom activities as an important factor in developing students' critical thinking, generalization and abstraction skills (Boaler, 2001; Kertil & Gürel, 2016; Lesh & Zawojewski, 2007; Lingefjard, 2006; NCTM, 2020). The purpose of mathematical modelling; to reveal students' creative and critical aspects, to help them develop positive attitudes towards

mathematics, to teach them to easily understand mathematical concepts, and to solve and formulate unique problems.

Many researchers on mathematical modelling have pointed out different modelling approaches (Borromeo, Ferri, 2006; Hıdıroglu & Bukova Güzel, 2013; Kaiser & Sriraman, 2006; Maaß, 2006). The most generally modelling approach consists of simplification, mathematization, interpretation and verification stages as a cyclic process. From this point of view, the simplification is more understandable to the visual skills of any problems encountered in real life and the students' visual skills. Mathematization can be expressed as the transformation of mathematical models that students create in their minds into mathematical expressions through symbols. Interpretation and Verification can be expressed as the accuracy of the mathematical models they form in their minds to be controlled by themselves and interpret the results according to daily life (Borromeo & Ferri, 2006; Maaß, 2006; Verschaffel, Greer & De. Corte, 2002).

Stem Education and Mathematics

STEM education is an interdisciplinary approach that covers the entire educational process from pre-school to higher education (Gonzalez & Kuenzi, 2012; Hom, 2014). Many researchers describe STEM education as an integrated approach that combines science, engineering, technology and mathematics disciplines with different subjects in daily life (Berlin & White, 2012; Cakıroglu & Dedebas, 2018). From this point of view, mathematical modelling also includes science, engineering and mathematics by dealing with open-ended real-life problems. Again, mathematics plays a very important role in the process of understanding and predicting the world, which is a fundamental purpose of STEM education. Therefore, experiencing real-life applications and mathematically modelling real-world situations are at the heart of effective STEM education (Fitzallen & White, 2012; Cakıroglu & Dedebas, 2016). In this context, mathematical modelling studies, which are one of the tools that enable the transition to STEM education, provide students with the opportunity to create models for the solution of real-life problems, enable students to develop thinking skills and use their science, and technology and engineering knowledge and designs in the problem-solving process (English, 2009; Chamberlin & Moon, 2006; Dogan et al, 2018; Zieffler & Garfield, 2009; Lesh & Caylor, 2007; Lesh, Hoover, Hole, Kelly, Post 2000; Shahbari & Peled, 2017).

On the other hand, STEM education teaches students to look at the problems they encounter in daily life with an interdisciplinary approach and provides opportunities for students to renew themselves and increase their capacities. Many researchers emphasize that with STEM education, students have made significant progress in becoming students who are interested in learning, actively participating in discussions and questioning (Breiner, Harkness, Johnson & Koehler, 2012; Kovarik, et al., 2013). In this context, it is very important to implement an integrated education model in schools with the STEM education approach. Integrated education improves students' ability to relate to real-world problems, their ways of thinking, their problem-solving and reasoning skills, their ability to use science and technology for mathematical concepts, and better understanding is achieved through interdisciplinary connections. Again, many researchers emphasize the importance that activities prepared within the scope of STEM education should aim to develop students' skills such as analyzing, producing, designing, expressing mathematically and communicating (Berlin & White, 2012; Bryan, Moore, Johnson & Roekrig, 2015; Bybee, 2013; Corlu, Capraro & Capraro, 2014). Content or context dimensions are the most used STEM approaches in implementing STEM education (Roehrig, Moore, Wang & Park, 2012). In this context, in the content dimension, the relevant fields are organized as a single field, and the program is prepared in a holistic way, while in the context dimension, a discipline is taken to the center and other disciplines are used to teach this discipline.

Method

This research, was carried out to examine the effect of mathematical modelling activities on theirs mathematical modelling skills in the context of STEM education and make a contribution to the field, was designed according to the embedded design, which is one of the mixed research methods. Embedded design are a pattern that emerges by taking one of the researcher's quantitative or qualitative research designs as the basis and embedding the other design (Creswell 2018; Creswell & Plano Clark, 2017). This study investigated the effect of mathematical modelling activities based on STEM approach on students' modelling success. In this study, a quasi-experimental design with a pretest posttest control group was used. In this process, the data obtained by taking the opinions of the students on mathematical modelling activities based on the STEM approach were also supported with quantitative data.

Study Group

The study group of research consists of a total of 66 eighth-grade students studying in a public school in the central district of a large province in the south of Turkey in the 2020-2021 academic year. In this context, 33 students in the study group, who were educated in the elective Mathematics Applications Course, were determined as the experimental group and 33 as the control group. The experimental group consisted of 15 female and 18 male students; the control group consisted of 17 female and 16 male students. In the determination of the study group according to the criterion sampling method, the students; It was taken into account that they regularly attend school, are open to learning new methods in teaching, have a more positive attitude towards the lesson, and participate voluntarily in the implementation process.

On the other hand, the study group consisting of 7 students, which is within the scope of the qualitative dimension of the study, was determined according to the maximum diversity sampling, one of the purposive sampling methods. According to the maximum diversity sampling, research should reflect the diversity of individuals who may be a party to the problem at the maximum level (Morgan & Morgan, 2009; Neuman & Robson, 2014; Patton, 2014). Within the scope of this study, the effect of mathematical modelling activities on students' mathematical modelling skills in the context of STEM education was examined according to the views of students with different mathematical achievements. Accordingly, two of these students have low, two have medium, and the other three have a high level of mathematics achievement.

Data Collection Tools

In this study, respectively Mathematical Modelling Problems in the Context of STEM education and Evaluation Rubric developed by the researchers as quantitative data collection tools; the Semi-structured Interview Form was used as a qualitative data collection tool. Information on data collection tools is given below.

1) Mathematical Modelling Problems in the Context of STEM Education

Mathematical Modelling Problems in the Context of STEM Education, prepared by using the related literature and covering multiple disciplines such as science, mathematics, technology and engineering in relation to real life situations. It consists of "Water Waste", "Electricity problem", "Biopsy" and "Bicycle Safety" problems. Within the scope of the validity of the problems mentioned above, the opinions of one expert in mathematics education and two experts in the field of STEM education were consulted. In this context, the "Waste Water" and "Biopsy" questions were rearranged according to the students' levels. In addition, these problems were applied as a pilot to five eighth-grade students, apart from the study group, and no difficulties were encountered during the implementation process.

2) Evaluation Rubric

In the study, the evaluation Rubric developed by Kertil (2008) was used to determine the proficiency level of mathematical modelling activities in the context of STEM education. In this context, the stages in the mathematical modelling problem process are given in Table 1.

Names and Descriptions of Modelling Skills	
	A1: Making simplifying assumptions:
A: Identifying the problem	A2: Clarifying the goal
	A3: Formulating the problem
D. Francisco en la claire analitare directione citta	B1: Identifying variables, parameters and constants
B: Expressing and solving problem situations with mathematical formulas and equations	B2: Formulating mathematical expressions
	B3: Choosing and applying a mathematical model
C: Using verbal expressions to explain the solution	
D: Using graphical and diagram representations to	
explain the solution	
E: Checking against real life situation	

Table 1 Evaluation Rubric education

Each stage in Table 1 is evaluated as "No (0 points)", "Missing (1 point)" and "Correct (2 points)". Accordingly, the statement "None" indicates that the relevant stage was never observed in the solution process of the problem; the "Missing" statement indicates that the relevant stage is observed incompletely or incorrectly in the resolution process; The expression "correct" indicates that the relevant stage was observed fully and completely in the solution process.

Example; The scoring of the question named "Bicycle safety" in the Mathematical Modelling Activity in the Context of STEM Education is as follows:

The second second

Figure 1. Solution example of student number 39

When Figure 3 is examined, the solution stages of the student were evaluated as follows: Identifying and Simplifying Given (A1): At this stage, student 39 determined the variables for the solution of the problem. He obtained the dimensions of his heavy tonnage vehicles according to their types from their web pages. Thus, he determined the ones to be considered in the solution process of many assumptions (2 points)

Clarifying the Goal (A2): At this stage, he explained where the QR codes will be pasted, using the pictures. He clarified the target by choosing the one that is related to the solution of the problem among the many assumptions that can be considered for the problem situation (2 points)

Formulating the Problem (A3): At this stage, the problem is divided into sub-problems, such as sticking the QR codes and determining the blind spots of the warning systems in the helmets (2 points)

Identifying Variables, Parameters, and Constants (B1): At this stage, it was seen that the necessary variables, parameters and constants were determined to think routinely and reach the solution in the solution of the problem, but since there was no information about the calculation of the blind spots, this stage was evaluated as incomplete by the researchers (1 point).

Formulating Mathematical Expressions (B2): According to the solution of the problem, this step was under-scored (1 point) because the algebraic expression of the mathematical expressions stated verbally in the problem situation was missing.

Selecting and Applying a Mathematical Model (B3): This stage was considered incomplete because it verbally determined the correct mathematical modelling to solve the problem, but the calculations part was missing (1 point).

Using Verbal Expressions to Explain the Solution (C): Since the researcher used explanations for the solution of the problem in the verbal expressions of the group in this section, this stage was accepted as correct (2 points).

Using Graph and Diagram Representations to Explain the Solution (D): This stage was accepted as correct by the researcher since the representation of the solution was expressed with a figure (2 points).

Checking Against Real-Life Situation (E): It was accepted as correct at this stage since it was thought that testing the accuracy of the solution found in a real-life situation and, as a result, the solution process was planned. For example, researching the dimensions of heavy tonnage vehicles and using warning systems to identify blind spots for each of them is associated with daily life (2 points).

Examining Figure 3, and in accordance with the previous explanations, reveals that 39 coded students received a total of 13 within the scope of this activity.

3) Semi-Structured Interview Form

In the study, the semi-structured interview technique was used to examine the students' views on mathematical modelling activities based on the STEM education approach. In accordance with the purpose of the research, the use of improvised questions in addition to pre-prepared questions to obtain in-depth information from the participants is called the semi-structured interview technique (Fraenkel et al., 2012). The interview form prepared in this context was presented to the opinion of a STEM education expert and two mathematics education experts. The first question. The first question was re-expressed in line with the experts' opinions. The pilot study of the form mentioned above was carried out with two students other than the sample, and no problems were encountered in understanding and answering the questions.

Students participating in the interview were selected from the upper-middle-lower group of academic achievement in mathematics (Creswell & Plano Clark, 2017). During the interview process, the students were interviewed oneon-one for about 10 minutes. In the last stage, content analysis was performed on the obtained data, and appropriate codes and categories were defined.

Implementation Process

In this context, it was applied to the students as a pre-test in the first week of the seven-week implementation process and as a post-test in the last week. Only pre-test and post-tests were administered to the control group students; In the teaching process, the teaching approach included in the elective mathematics course and foreseen by the curriculum was applied. The tests and activities applied to the students in this process are given in Table 2.

Week	Application Name	Time
Week 1	Mathematical Modelling Problems in the Context of STEM Education Pre-Test (Stadium, Water Waste Problem, Bicycle Safety and Biopsy)	50+50 min
Week 2	Theoretical Information About STEM Education and Mathematical Modelling	50+50 min
Week 3	Mathematical Modelling Activity: Lemonade Sales	50+50 min
Week 4	Mathematical Modelling Activity: Height Footprint	50+50 min
Week 5	Mathematical Modelling Activity in the Context of STEM education: Electricity Generation	50+50 min
Week 6	Mathematical Modelling Activity in the Context of STEM education: Heat Insulation	50+50 min
Week 7	Mathematical Modelling Problems in the Context of STEM Education Post-Test (Stadium, Water Waste Problem, Bicycle Safety, and Biopsy	50+50 min

Table 2. Implementation process of the study

According to Table 2, in the first week of the application process, Mathematical Modelling problems in the context of STEM education were applied to the experimental and control groups, respectively, as a pre-test. During the application process, the experimental group was given information about mathematical modelling and its definition as theoretical knowledge, the definition and importance of the STEM education approach, and the problem-solving process. In the next stage, two mathematical modelling in the context of STEM education activities and two mathematical modelling activities were applied to the experimental group for a period of four weeks. In this context, each activity was applied to the experimental group by one of the researchers in the "Elective Mathematics Applications" course, which is two hours a week. On the other hand, in the control group, problems aimed at developing four-operation skills related to numbers and operations learning within the scope of the elective mathematics course were taught. Applications were applied to both groups by one of the researchers. At the end of the application, the mathematical modelling test in the context of STEM education was applied to the experimental and control groups as a post-test. The practitioner scored the data collected to evaluate the process and the result with an evaluation rubric to avoid bias. The 'Heat Insulation', 'Lemonade Sale', 'Electricity Production' and 'Length Footprint' activities applied during the implementation process are from the relevant literature (Karahan, & Bozkurt, 2017; Yüksel et al., 2019; Dede and Bukova, 2018; Cavus Erdem et al., 2018) in line with the readiness of the students. Again, importance was given to the preparation of the applied activities with an interdisciplinary perspective depending on STEM applications and to the features that students may encounter in daily life (Çavaş, Bulut, Holbrook and Rannikmae 2013). Two experts in STEM education and Mathematical modelling during the preparation, implementation and evaluation of these applications opinions were taken. The activities were finalized in line with the opinions of the experts.

On the other hand, in the first stage of the research, the students in the experimental group were given detailed information about how the implementation process would take place, and the necessary approval was obtained from their parents. In the next stage, the students were divided into heterogeneous groups of 4-5 students and the necessary equipment and technological equipment were made ready. Heterogeneous groups were formed by bringing together students from different backgrounds, with the help of classroom teachers, taking into account the students' academic success. In this context, the common steps followed for the implementation of each activity throughout the teaching process are as follows:

1. After the students were asked interesting and interesting questions about the activity, activity papers were distributed. During the process, it was stated that the students could ask about the things they did not understand and were curious about.

2. After the activity papers were distributed, the students were asked to read the problem in the activity silently.

3. Students who read the problem with the information presented in the activity were asked to express the problem in their own words.

4. After each student wrote their statement, they were asked to research what information they needed to solve the problem. When necessary, he can benefit from the internet environment. In addition, if needed, tools such as cardboard, rope, glue, and scissors are available in the classroom environment.

5. In the next step, students were asked to write down the solution path they would follow to solve the problem. While creating the solution path, it was tried to give clues to the students where deemed necessary.

6. After the students created their solutions, they were asked to solve the problem by following the solution they created.

7. After making the solution, the students were asked to explain the contribution of the solution of the problem to them and to associate the solution with daily life.

8. In the last stage, the students were asked to explain whether the solution they found was effective and how they were sure of the correctness of the solution.

Throughout the process, the researcher tried to direct the students to think. In this context, the teaching process has been tried to be carried out in a way that makes the student active. During the implementation process of each activity, the students tried to solve as a group. Afterwards, the posttest was applied. In the last stage, one-on-one interviews were conducted with the students in the qualitative research group.

Data Analysis

The quantitative data obtained from the research were analyzed using the IBM SPSS 22.0 statistical package program. In this context, the data were analyzed according to the normal distribution Skewness and Kurtosis values. As a result of the analysis, it was concluded that the skewness and kurtosis values of the pre-test and posttest results of mathematical modelling problems within the scope of STEM education have a normal distribution (George & Mallery, 2019; Tabachnick & Fidell, 2019). In this context, independent groups t-test and Cohen's d analysis for effect size were applied. Again, in the interpretation of the effect sizes, the classification introduced by Cohen (1988) was taken into account, and the obtained value was found to be .35. In this context, the fact that this value obtained is greater than .14 shows that the difference has a large effect.

On the other hand, the qualitative data obtained from the research were analyzed by content analysis method. Content analysis is an analysis process that includes in-depth analysis of the data and creating codes and categories according to the concepts obtained from the data (Fraenkel, Wallen & Hyun, 2012). In this context, in the research, the interview data were coded independently by two researchers, and a joint decision was reached on creating the categories. In addition, quotations from student opinions were included to support these categories. Instead of the names of the students participating in the interview, coding as S1, S2, S3... was used according to the order of the interview.

Finally, within the scope of the reliability of the qualitative data analysis, support was received from an expert in mathematics education and experienced in STEM education as a second coder. In this context, the data obtained from the second encoder was asked to be recorded, and the agreement between the researchers and the second encoder was calculated according to the formula "Reliability=Consensus/Consensus+Disagreement". According to the result obtained, the concordance value between the encoder and the researchers was calculated as .92. A coherence value above .70 indicates that the codes and themes are reliable (Miles & Huberman, 1994).

On the other hand, within the scope of the ethical measure taken in the context of the research, all students and parents were informed about the content of the study at the beginning of the study by obtaining the necessary official permissions from the University ethics committee. Again, within the scope of ethical permissions, students and parents participating in the research were informed that they could leave the research at any time, and a signed parent consent form was obtained from those who voluntarily participated in the study. In addition, codes were used to keep the students' identities confidential and stated that all data would only be used within the scope of this research.

Results

Findings Concerning the Results of Mathematical Modelling Problems in the Context of STEM Education Before the application, the students in the experimental and control groups were pre-tested on mathematical modelling problems in the context of STEM education, and the significance of the difference between the two groups was evaluated with the independent group t-test. In this context, it was concluded that the mathematical modelling problems of the experimental and control groups in the context of STEM education did not cause a significant difference in terms of pre-test results [t(64)= -0.772, p>.05]. Then, after the experimental process, the mathematical modelling test post-test scores of the experimental and control groups in the context of STEM education were analyzed with the independent group t-test. The findings are shown in Table 3.

Table 3. Independent Groups t-Test Results for Comparison of Post-Test Scores of Mathematical Modelling Problems in the Context of STEM Education

	Groups	Ν	X	Ss	sd	t	р	d
Post-Test	Experimental Group	33	36.66	8.81	32 5.369	5 360	.000	35
	Control Group	33	15.06	6.06		5.509		.55

When Table 3 is examined, it is seen that the mathematical modelling problems of the experimental and control groups in the context of STEM education cause a significant difference in terms of post-test results. (t(32)=5.369; p<.01). Accordingly, it can be said that the students in the experimental group were more successful than those in the control group. However, the calculated effect size value as .35 also shows that the procedure performed in the experimental group had a great effect.

Within the scope of the second sub-problem of the research, the opinions of the students in the experimental group, in which mathematical modelling activities were applied in the context of STEM education, about the teaching process are given in Table 4.

Table 4. Student	Views on Mathematical	Modelling A	Activities in the	Context of STEM	Education

Categories	Codes	f
	Different Perspective	4
Comitivo Fosturo	Thinking Skill	3
Cognitive reature	Better Learning	2
	Logical Thinking	1
	Increased Desire for Problem Solving	5
Mathematical Literacy Skills	Ability to Collaborate with the Group	5
	Ability Solve Real Life Problem	2
	Interest in Modelling and Problem Solving	3
Contribution of STEM Education	Engineering Field interest	2
	Technology interest	1
Affactive Trait	Fun	2
Affective frait	Beneficial	2

	Motivating	1
	Intriguing	1
	Difficult Problems	7
The Diff and the Francisco of	Complex Problems	4
The Difficulties Experienced	Contains More information	1
	Joint Decision Making with the Group	1

As can be seen from Table 4, student views on mathematical modelling activities in the context of STEM education are grouped into five main categories. These categories are cognitive feature, mathematical literacy skills, contribution to STEM education, affective trait and the difficulties experienced. Accordingly, in the cognitive feature category, which is the first category, students state that they gain the most different perspectives and that STEM education improves their thinking skills. In this context, for example, the student coded S5 said, "We had a hard time solving-problems at first, but when we discussed it with friends, and we understood how we could solve the problem when everyone said something different. I always like to solve such problems. Because such problems allowed me to think better, make the right decision, have many possibilities, and have a different perspective while solving the question".

In the second category, in the context of mathematical literacy skills, students mostly state that their desire to solve problems increases, they can cooperate with their groupmates and easily solve real-life problems. In this context, for example, the student's interview coded S1 said, "We first had difficulties in solving the problems, but then we solved them easily. It was fun trying to solve the problem with our group mates. Different ideas of my friends made it easier for me to solve the question. I always want to solve such questions in mathematics."

Regarding the contribution of STEM education in the third category, three students stated that their interest in modelling and problem solvingproblem-solving increased. In contrast, the other two stated that their interest in the field of engineering increased. In this context, for example, the student coded S7 said, "We did not understand at all when we first started the activities. Then when it was explained and tried to solve, I saw many examples of questions. I heard different ideas and learned. From now on, I think I will understand more easily when solving problems. In the future, I plan to study STEM. I especially want to improve myself in the field of engineering."

In the category of affective trait, students stated that mathematical modelling activities in the context of STEM education are fun, useful, motivating and intriguing. In this context, for example, the student coded S2 commented, "The problems were fun, and they made us think. We can force our brains more in the face of a problem. This allows us to learn mathematics better. Since there are such problems in real life, I will no longer ask my teacher what mathematics will do for us. Now when I encounter such a problem, I think I will solve it."

Finally, in the final category of difficulties, students stated that the problems in the mathematical modelling activities within the scope of STEM education were difficult, complex, and overly detailed, and that they struggled to make a joint decision with the group in solving the problems. In this context, for example, student coded S6 said, "When I started the activities, I had difficulties with the problems. It was difficult for me at first because his problems were real-life related. However, as the group debated with their peers, these difficulties began to disappear. After that, things began to flow more smoothly. Then I understood how to think and solve in such events." expressed his opinion.

Discussion

In the context of this research, it was concluded that the STEM education provided caused a significant and positive difference in the post-test scores of the students in the experimental group compared to the students in the control group in terms of mathematical modelling. In other words, it can be said that theoretical education and given activities significantly increase students' mathematical modelling skills in the context of STEM education. Similar results were also obtained in studies conducted in the related literature (Arleback, & Albaraccin, 2019; Ceylan & Karahan, 2021; Derin & Aydın, 2020; English, 2016; Güder & Gürbüz, 2018; İncikabı, 2020; Mass & Engeln, 2019; Maass, Geiger, Ariza & Goos, 2019; Wiedemann, 2020). In this context, for example, Arleback and Albaraccin (2019) emphasize that mathematical modelling is at the center of STEM and that mathematical modelling supports the development of twenty-first century skills in STEM disciplines.

Again, Guder and Gurbuz (2018) revealed that mathematical modelling activities can be used as an interdisciplinary tool in STEM education, and that interdisciplinary mathematical modelling activities improve students' academic success and skills and cause positive attitudes towards mathematics. Similarly, Ceylan and

Karahan (2021) found that there were positive developments in students' knowledge and attitudes about mathematics and STEM fields after STEM-oriented mathematical modelling activities. In addition, Derin and Aydın (2020) revealed that mathematical modelling activities applied in the context of STEM education lead to significant improvements in both mathematical modelling competencies and problem-solving skills of pre-service teachers. Wiedemann (2020), on the other hand, revealed that in the context of STEM education, by combining computer-assisted mathematical modelling activities with real-world mathematical modelling experiences, students better grasp the solutions for the mathematical modelling process.

On the other hand, within the scope of the other sub-problem of the research, it was concluded that the students participating in the interview in the experimental group gained a different perspective with the mathematical modelling activities applied in the context of STEM education, they experienced positive developments in their thinking skills, they adapted to group work more easily, and their interest in engineering and technology increased. In this context, when the relevant literature is examined, it is seen that the studies conducted point to similar results (Derin & Aydın, 2020; Doruk, 2010; Güder & Gürbüz, 2018; Gümüş, 2019; Sağırlı, 2010; Zawojewski, Lesh & English, 2003).

Finally, in the study, it was concluded that with the help of mathematical modelling activities applied in the context of STEM education, students could more easily overcome the problems they encountered in real life and create many, alter, native solutions to them. Similar studies in the literature indicate similar results (Gümüş, 2019; Sandalc1, 2013; Sağırl1,2010). In this context, Sandalc1 (2013), for example, revealed a positive increase in the level of noticing mathematics in daily life after the mathematical modelling activities of sixth-grade students. Similarly, Doruk and Umay, (2011), as a result of their study on sixth and seventh-grade students, revealed that with the help of modelling activities, students experienced positive developments in their ability to transfer mathematics to daily life. Again, Sagirli (2010) found that with the help of mathematical modelling problems, 12th-grade students' ability to adapt, use and interpret mathematics to daily life improved. In addition, as a result of his study examining the interests and views of secondary school students in STEM education, Gumus (2019) revealed that STEM education increased students' academic success and caused positive developments in their daily life skills and awareness levels.

Conclusion

As a result, within the scope of this study, it was concluded that mathematical modelling activities in the context of STEM education positively improved the mathematical modelling skills of secondary school students. In addition, it was concluded that the students who received education with mathematical modelling activities applied in the context of STEM education gained different interdisciplinary perspectives, experienced positive developments in their thinking skills, adapted to group work more efficiently, and their interest in engineering and technology increased. Accordingly, it can be suggested that more mathematical modelling activities based on the STEM approach should be included in the mathematics curriculum to raise individuals who can use mathematics more effectively in real-life problems and associate it with other disciplines. On the other hand, this study is limited to a seven-week education period with secondary school eighth-grade students. More comprehensive longitudinal studies can be conducted with students at different education levels in this context.

Author (s) Contribution Rate

All authors contributed equally to the article.

Conflicts of Interest

There is no conflict of interest.

Ethical Approval

Ethical permission (29 Mart 2021- E-95704281-604.02.02-65535) was obtained from Çukurova University Scientific in Social and Human Sciences Research and Publication Ethics Committee institution for this research.

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Sorry, I Can't Open My Camera! Social Anxiety Levels of Prospective Teachers In E-Learning Environments During Covid-19 Pandemic

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Sorry, I Can't Open My Camera! Social Anxiety Levels of Prospective Teachers In E-Learning Environments During COVID-19 Pandemic

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Abstract

The present study aims to determine the social anxiety levels of prospective teachers in e-learning environments. The research adopts the cross-sectional survey model. The study group consists of 506 pre-service teachers through a convenience sampling technique from a state university in northern Turkey during the fall semester of the 2021-2022 academic year. The data are collected online through the "Social Anxiety Scale for E-Learning Environments" in the spring semester of the 2021-2022 academic year. The study found that teacher candidates have a moderate level of social anxiety in e-learning environments which unfavorably affects academic achievement. Moreover, it is concluded that gender is not directly affecting social anxiety in e-learning environments, but the grade level is influential on social anxiety. There is a positive correlation between prospective teachers' self-efficacy in using computers and their social anxiety levels in e-learning environments. This study has revealed new empirical results on the reflections of social anxiety in e-learning environments. The results are discussed in line with the relevant literature and some recommendations are made.

Keywords: Teacher education, Student teacher, E-learning, Distance learning.

Introduction

COVID-19 has been considered the worst pandemic and "public enemy number one" in the millennium. It has changed how we live in the blink of an eye, threatening our existence and health and damaging our economic, social, and educational systems (Khoshaim, 2020). COVID-19 has influenced all the countries in the world in terms of health, economy, sociology, politics, culture, and many others. Undoubtedly, the field of education is among those (Nambiar, 2020; Callaway, et al., 2020; Alea, Fabrea, Roldan & Farooqi, 2020; Korkmaz & Toraman, 2020; Bakioğlu & Cevik, 2020; Özdemir & Önal, 2021; Kedraka & Kaltsidisi, 2020). As a global health problem, COVID-19 has dramatically changed life sciences and education in particular (Arribathi, 2021; Mailizar, Almanthari, Maulina & Bruce, 2020; Stambough et al., 2020; Tümen-Akyıldız, 2020; Carrillo & Flores, 2020; Yükselir & Yuvayapan, 2021). To fight against the pandemic, countries have developed several strategies, and one global strategy is to control the spread of the virus. One of the wisest measures is to close schools and prevent students and instructors from becoming infected (Germann et al., 2019). With the closure of schools, education has become greatly affected by the COVID-19 epidemic. More than a billion students worldwide have been overcome by the closure of schools and universities due to the pandemic (United Nations Educational Scientific and Cultural Organization [UNESCO], 2020). As an effortless and applicable solution, distance education has been introduced to minimize suffering and ensure the sustainability of education (Tümen-Akyıldız & Donmus-Kaya,2021). In other words, rapidly developing educational technologies in the digital world have emerged as the most appropriate teaching instruments during the pandemic. As a result of this, distance education, which has become an inevitable way out, has begun to be accepted as an effective means of education by large masses. Additionally, all the countries have developed new ways to maintain their educational procedures within the framework of the emergent education system in the world (Gilani, 2020).

Distance education has emerged based on the needs of society. Undoubtedly, the concept of distance education was born of a need that is true for all innovations and inventions in the world (Süğümlü, 2021). Distance education, which has appeared as an alternative to traditional face-to-face education, is deemed as a promising innovation and development with flexibility in learning environments (Allen et al., 2010). Distance education has indeed created an alternative form of education by removing the boundaries of time and space (Bilgiç & Tüzün, 2020). However, many dissimilarities have been experienced due to suspending face-to-face education activities in

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universities and implementing online education systems instead (Bao, 2020). As a result of the closure of educational institutions, teachers and students had to adapt to distance learning quickly (Carrillo & Flores, 2020). Teachers and students have experienced various challenges during the distance education (Atreya & Acharya, 2020). Arrangements, which were caught off guard due to their urgent presentation, created psychological, social, and academic problems for university students and they underwent hard tests (Brooks, 2020).

Social anxiety has always been a concern of traditional face-to-face education but has rarely been studied in elearning settings. Education for the 21st century should consider societal interests and needs (Arribathi et al., 2021). In line with this requirement, a better understanding of social anxiety as a feature that affects interaction and communication in e-learning environments in online education can contribute to the design of more effective learning environments, the development of effective e-learning pedagogies, and the organization of learning environments for practitioners (Bahçekapılı, 2021; Khoshaim, 2020). Therefore, the present study aims to determine the social anxiety levels of prospective teachers in online lessons and to make recommendations in light of the obtained results. The next section of the paper presents the definition of the variables, the theoretical foundations explaining the relationships between them, and the hypotheses.

Online Education and E-learning Environments

Online education has emerged as a strong alternative for maintaining educational procedures, especially during the COVID-19 (Radha et al., 2020; Tamborra, 2021). Most institutions still offer online programs to facilitate learning in our digital age. Online education technology serves to disseminate knowledge (Vaona et al., 2018). The development of information technologies in higher education becomes more evident, particularly with e-learning implementation. E-learning facilitates students' access to information and provides students with a flexible learning opportunity by eliminating physical limitations in face-to-face learning (Kumar, Wotto & Bélanger, 2018). Triggered by growing concerns about the COVID-19 pandemic, all on-campus facilities such as educational activities, workshops, conferences, and sporting events have been postponed/canceled by an increasing number of universities around the world starting in March 2020 and universities quickly transferred various courses and programs to the online environment (Sahu, 2020; Trevisan, De Rossi & Grion, 2020). Face-to-face education and learning processes had to fit the e-learning setting (Wu & McGoogan, 2020). Therefore, e-teaching and learning activities started being carried out online. As a result, the COVID-19 epidemic has had a significant impact, especially on the learning process, and online education has become the only way to carry out educational activities (Gottardo & De Martino, 2020; Falcinelli & Moscetti, 2021; Setianingsih et al., 2019).

The distance education system has both advantages and disadvantages (Pürsün et al., 2021; Süğümlü, 2021). Keskin et al. (2020) assert that various obstacles may hinder learners' social interactions. However, e-learning technologies and social learning environments have become online environments that students can access from anywhere and anytime without the need to be physically there. These new technologies have increased the opportunities of interaction to a great extent. Such factors as social anxiety, academic and technical skills, unreadiness for e-learning, self-regulation, motivation, communication skills, low technology literacy, restrictions, self-efficacy, technophobia, and time can be listed among those barriers (Song et al., 2004; Hill et al., 2009). E-learning has been adopted internationally as an alternative learning and teaching strategy to fill the academic gap created by the current reality of worldwide closures during COVID-19 quarantine (Fawaz & Samaha, 2021).

E-learning is a critical and powerful solution to meet education demand for today's higher education institutions. Most of today's educational institutions offer blended and online courses, and many students attend these courses regardless of time and place limitations. Students' experiences in online learning environments can provide important information to researchers about the quality of education and how much students benefit from online environments. In this direction, these experiences can be explained with the concept of "interaction", which is one of the most important concepts that reveal the quality of e-learning (Miranda & Vegliante, 2019). The most important problem in the distance education process is the decrease in student willingness and motivation due to the lack of face-to-face interaction (Galusha, 1998; Özdoğan & Berkant, 2020). Studies indicate that one of the most important problems in distance education is the lack of interaction (Hebebci, Bertiz & Alan, 2020; Tümen-Akyıldız, 2020; Chen et al., 2001; Jin, 2005; Falowo, 2007). Communication and interaction can directly affect several pedagogical factors such as students' motivation, engagement, satisfaction, and academic achievement (Bahçekapılı, 2021; Can & Bozgün, 2021; Tzafilkou, Perifanou & Economides, 2021). Undoubtedly, the COVID-19 process has become the primary reason for the transformation of face-to-face learning to e-learning. This transition has revealed diverse problems between students and teachers, including technical and psychological difficulties (Arribathi, 2021; Pürsün et al., 2021). Apart from the risk of death, the pandemic has yielded unbearable psychological problems and pressures on people worldwide (Xiao, 2020; Biswas & Biswas, 2021). With the closure of all educational institutions, university students were also quarantined and participated in the new academic semesters remotely via e-learning, thus experiencing different levels of psychological pressure

(Wang & Zhao, 2020). These include anxiety and social anxiety. Thus, anxiety has recently become a critical factor both in education and distance education (Ajmal & Ahmad, 2019).

Social anxiety

Recently, interest in social anxiety has been growing due to the high frequency of cases diagnosed with severe anxiety and depression (Izgic, Akyüz, Doğan & Kuğu, 2004). Anxiety is defined as "the anticipation of a future threat" (American Psychiatric Association [APA], 2013, p.189). On the other hand, social anxiety is described as the fear of being negatively judged, humiliated, or making a negative impression by others, and doing something wrong (APA, 2000; Persons & Tompkins, 2011). Social anxiety or social interaction anxiety is the fear of unfamiliar people, environments, and situations or social situations in which the individual is exposed to scrutiny (Çuhadar, 2012). Individuals may fear that they are being watched or observed by others, fear that they will be evaluated negatively, and may experience social anxiety. The evaluation of oneself by others can lead to social anxiety, avoidance behaviour, fears, and personal disorders. Thus, anxiety or fear can create problems in speaking, performance or motivation in social situations (APA, 2013). Social anxiety plays an active role in educational processes. It can be claimed that failure to succeed caused by anxiety or ideas about the obstacles to success may harm learning processes (Can & Bozgün, 2021). Similarly, Russell & Topham (2012) suggest that social anxiety can impair the academic achievement of universities/university students.

There is a strong relationship between the type of communication (online or face-to-face) and social anxiety (Behrens & Kret, 2019). Accordingly, it is emphasized that students experience higher anxiety levels in distance education than in traditional learning environments (Ajmal & Ahmad, 2019). D'Errico et al. (2016) found that anxiety is a significant element that negatively impacts student performance and motivation in online education. Consistently, anxiety causes students to perform poorly (Ajmal & Ahmad, 2019).

Social anxiety is a decisive factor affecting online interaction (Hutchins et al., 2021). In this context, the most important factors are the types of interaction that indicate what and with whom learners interact. The types of interaction during distance education and e-learning fall into three subcategories: (1) interaction with the instructor, (2) interaction with content, and (3) interaction with learners (Moore, 1989; as cited Keskin et al., 2020). Anxiety is very common in teaching-learning processes, but both students and teachers should eliminate anxiety to achieve predetermined learning goals (Arribathi, 2021). Social anxiety is one factor affecting students' success in online education (Ajmal & Ahmad, 2019). Social anxiety is associated with a great many psychoeducational structures (Keskin et al., 2020). The conceptual framework regarding the learning anxiety of the students in online education is given in Figure 1 to depict the overall picture:



Figure 1. The conceptual framework of student learning anxiety in online education

Figure 1 draws attention to the impact of COVID-19 on learning anxiety in higher education (Arribathi, 2021). In the wake of distance education due to the COVID-19, a number of research has focused on the analysis of the psychological consequences on students' mental health and academic achievement, and an increase in mental health problems such as moderate or severe stress, depression, and decreased emotional self-efficacy among university students have been proven (Tzafilkou et al., 2021). Students' anxiety stemming from various reasons during distance education is directly related to the change in the learning process, learning motivation, and learning success. Undoubtedly, the main factors of e-learning are learning style, enthusiasm, and success, and they are directly related to learning anxiety. On the other hand, anxiety in distance learners in online education is mainly caused by their life experiences and their relevant expectations/assumptions (Ajmal & Ahmad, 2019). Some of the other important factors are technological infrastructure, instructor characteristics, e-learning systems, support, e-learning resources, and training provided to online education (Alhabeeb & Rowley, 2018).

Social Anxiety in E-Learning Environments

COVID-19 has created widespread fear and anxiety worldwide, causing social and physical problems as well as psychological disorders (Ahmad & Husain, 2020). Díaz-Jiménez et al. (2020) concluded that there is a high number of anxiety symptoms for students who have difficulty adapting to distance education. Such factors as future anxiety and changing the place of residence boost the frequency of anxiety symptoms. Similarly, Kocaman and Ersoy (2021) confirmed in their study that students are worried about the uncertainty in the resumption of face-to-face education, the way the exams are conducted, the technical problems experienced during e-learning, and the lack of understanding of the course topics due to the ongoing pandemic. As can be seen, several situations determine social anxiety in e-learning environments. In their study, Fawaz and Samaha (2021) found that elearning via online platforms causes depression, stress, and anxiety disorders in students. On the other hand, Ajmal and Ahmad (2019) pointed out that factors such as the gap in the adaptation process to distance education, lack of materials, lessons, and support cause anxiety among students. Undoubtedly, it is normal for students to encounter problems during e-learning as they experience psychological problems during distance education. Such variables as the father's level of education, family size, place of residence, academic year, type of housing, and access to high-speed internet also affect students' level of anxiety as the determinants of anxiety (Hoque et. al., 2021). Additionally, students' digital skills are also important for social anxiety in e-learning environments. It has been revealed that the more students have digital skills, the less they experience social anxiety. Students who do not actively participate in the lessons and do not interact and communicate with the teacher through online channels or live chat are more anxious (Bahçekapılı, 2021).

A great many factors may cause and trigger social anxiety in e-learning environments. Gender is among the leading ones (Alsudais et al., 2022; Khoshaim et al., 2020). It may be the gender of the other party that precipitates and exacerbates social anxiety (Erkan, Güçray & Çam, 2002). It was revealed that social anxiety is more common in women than in men university students (Dell'Osso, 2015; Bahçekapılı, 2021). The gender factor also has a decisive effect on the overall level of anxiety (Hoque et al., 2021). In addition to gender, the individuals' age may affect their social anxiety levels in e-learning environments (Alsudais et al., 2022). The age factor, which is highly correlated with the overall anxiety level (Khoshaim et al., 2020), may significantly affect the level of social anxiety. The level of academic achievement is also important besides age and gender in determining social anxiety in e-learning environments (Alsudais et al., 2022). It was noted that anxiety significantly impacts the academic performance of distance learners (Díaz-Jiménez et. al., 2020; Ajmal & Ahmad, 2019). Brook and Willoughby (2015) found that social anxiety has a significant and negative direct relationship with academic achievement. Similarly, it was revealed that students with low performance during e-learning have higher social anxiety levels than students with high performance (Alsudais et al., 2022). The high performance of students in e-learning is acceptable. Learning anxiety that directly affects e-learning is offline interaction, learning motivation, and change in learning mode (Arribathi, 2021).

Current Research

The present study's main aim is to determine prospective teachers' social anxiety levels in online courses. For this purpose, answers to the following questions were sought:

1. What is the social anxiety level of the participants in their interactions with both other learners and the instructor in e-learning environments?

2. Do the social concerns of the participants in their interactions with both other learners and the instructor in elearning environments negatively predict their academic achievement?

3. Do the participants' mean scores for the sub-dimensions of avoidance of interaction, somatic symptoms, and negative evaluation differ significantly by gender and grade levels?

4. What is the relationship between the self-efficacy perceptions of the participants in using computers and their social anxiety in their interactions with other learners and the instructor in e-learning environments?

Method

This study was designed with a cross-sectional survey model. In cross-sectional studies, where the sample is huge and consists of a great many different qualities, the variables to be investigated are measured at once (Fraenkel et al., 2012).

Research Context and Sample

The study group consists of 506 prospective teachers determined through a simple random sampling technique from a university in northern Turkey during the fall semester of the 2021-2022 academic year. The data were collected in January 2021 using an online questionnaire. To determine the academic performance of the students, participants were asked to record their current grade point average. The personal data of the study group are shown in Table 1.

Variable	Catagory	Frequency	Percentage
variable	Category	f	%
	Freshman	113	22,3
Grade Level	Sophomore	127	25,1
	Junior	152	30
	Senior	114	22,5
	Total	506	100
	Female	283	55,9
Gender	Male	223	44,1
	Total	506	100
	Math	87	17,2
	Psychological Counseling and Guidance	77	15,2
	Social Studies	77	15,2
Branch	Turkish Language	84	16,6
	Science and Technology	90	17,8
	English Language	91	18
	Total	506	100

Table 1. Demographics of the study group

Instruments Used and Their Validation

"The Social Anxiety Scale for E-Learning Environments (SASE)" developed by Keskin and colleagues (2020), was used to measure the social anxiety level of the study group in e-learning environments. The 7-point Likerttype scale includes two themes dealing with learner-learner interaction and learner-instructor interaction. Each theme consists of the sub-dimensions of negative evaluation (9 items), somatic symptoms (4 items), and avoidance of interaction (10 items). High sub-dimension scores imply a high level of social anxiety in e-learning environments. Sample items and Cronbach's alpha internal consistency coefficients for the sub-dimensions of the scale are given in Table 2.

Table 2. SASE Sub-dimensions and alpha internal consistency coefficients

Dimension	Alpha	Sample Items					
Negative Evaluation	.94*	*In e-learning environments, I worry about being seen as an idiot because of my questions on talk pages.					
	.96**	.96** **When communicating with the instructor in e-learning environments, I the what I write will be negatively evaluated.					
Somatic	.88*	*My heart starts beating fast as I communicate on talk pages in e-learning environments.					
Symptoms	.92**	**When communicating with the instructor in e-learning environments, I get restless when communicating.					
Avoidance	.95*	*In e-learning environments, I prefer to remain silent to avoid making a bad impression on the talk pages.					
Interaction	.96**	**In e-learning environments, I find it difficult to ask for help when I need to communicate with the instructor.					

Note. Learner-Learner, **=Learner-Instructor

Table 2 indicates that the alpha internal consistency coefficients of the sub-dimensions for both scale themes are excellent. The confirmatory factor analysis (CFA) results for the 23-item sub-theme addressing the learner-learner interaction revealed that the original three-dimensional structure was confirmed and the fit indices were acceptable, $\chi 2 = 842,372$, df =219, p<.000, $\chi 2/df$ =3,846, IFI=.95, SRMR = .03, RMSEA = .07, CFI=.95, TLI= .94. The confirmatory factor analysis (CFA) results for the 23-item sub-theme addressing the learner-instructor interaction yielded that the original three-dimensional structure was confirmed, and the fit indices were acceptable, $\chi 2 = 826,296$, df =221, p< .000, $\chi 2/df$ =3,739, IFI = .96, SRMR = .02, RMSEA = .07, CFI=.96, TLI= .95. The pre-service teachers' self-efficacy in using computers was estimated through a single item ranging from 1 to 5.

Data Analysis

Analyses were conducted respectively to the research questions. Firstly, descriptive statistics and normality tests were estimated for the relevant variables. Secondly, multiple regression analyses were performed to predict academic achievement. Thirdly, one-way analysis of variance and t-test tests were conducted for variables such as gender and grade levels. Lastly, the Pearson product-moment correlation coefficient was calculated, and

multiple regression analyses were performed to reveal the relationship between the variables. SPSS software package was used in statistical analyses. The significance value of .05 was adopted for all statistics.

Findings

This section presents the research findings in the order of sub-goals of the study.

Findings Regarding the First Sub-goal

The social anxiety levels in their interactions with other learners and the instructor in e-learning environments are submitted in Table 3.

		Learner-Lear	ner	Learner-Instructor				
	Negative	Somatic	Avoidance of	Negative	Somatic	Avoidance of		
	Evaluation	Symptoms	Interaction	Evaluation	Symptoms	Interaction		
Mean	3,62	3,42	3,49	3,59	3,40	3,30		
Std. Dev.	1,59	1,68	1,61	1,71	1,82	1,65		
Skewness	,15	,29	,28	,18	,293	,40		
Kurtosis	-,941	-,954	-,854	-1,063	-1,150	-,907		
Minimum	1	1	1	1	1	1		
Maximum	7	7	7	7	7	7		

Table 3. Social anxiety levels of participants

As can be inferred from the skewness and kurtosis values in Table 3, the variables are normally distributed (kurtosis and skewness $\leq |2|$). It can be claimed that the participants' social anxiety levels are moderate.

Findings Regarding the Second Sub-goal

The results of the multiple regression analysis performed to determine the effect of the sub-dimensions of SASE on academic achievement (dependent variable) are shown in Table 4.

Table 4. Multiple Regression Model for Predicting Academic Achievement

Variable	В	Std. Er.	β	t	р	Partial r	Part r	Tolerance	VIF
Constant	3,429	,044		78,018	,000,				
Negative Evaluation*	-,106	,041	-,420	-2,611	,009	-,270	-,118	,072	9,896
Somatic Symptoms*	,051	,031	,215	1,627	,104	-,214	,074	,106	9,411
Avoidance of Interaction*	,028	,042	,113	,666	,506	-,270	,030	,065	8,490
Negative Evaluation**	,065	,041	,275	1,599	,110	-,249	,072	,063	7,977
Somatic Symptoms**	-,004	,030	-,019	-,143	,886	-,231	-,007	,101	9,855
Avoidance of Interaction**	-,108	,036	-,444	-3,007	,003	-,292	-,135	,085	9,785
R=.320	R2	= .103							
F(6-485) = 9,245 $p = .000$)								

Note. *= Learner-Learner, **= Learner-Instructor

To meet the assumptions of multiple regression analysis, we checked that the variables were normally distributed, and the Mahalanobis distance was estimated for outliers in SPSS. Based on the chi-square critical value table given by Tabachnick & Fidell (2013, p. 952), 14 data above the 22.45 value, corresponding to 6 degrees of freedom for the .001 significance level, were excluded from the analysis as being outliers. Additionally, tolerance and VIF values were examined to reveal whether there was multicollinearity between the independent variables. Table 4 indicates that the tolerance values of each independent variable included in the multiple regression are greater than .20, and the VIF values are less than 10. These findings suggest that each independent variable observed in the multiple regression model measures a different attribute; that is, there is no problem with multiple correlations between the independent variables.

Multiple linear regression analysis performed to determine how the independent variables predicted the academic achievement of the participants revealed a significant relationship between the variables. (R = .320, R2 = .103) with the academic achievement [F (6-485) = 9,245, p< .01]. All of the independent variables together explain 10.3% of the variance in academic achievement scores. The significance tests of the standardized regression coefficients indicated that only negative evaluation (learner-learner) (β = -.42) and avoidance of interaction (learner-instructor) (β = -.42) variables were the significant predictors of academic achievement (p<.01).

Academic achievement has a significant negative relationship with negative evaluation (learner-learner) by $r = -.270(-.118 \text{ when the effect of other independent variables is under control), and avoidance of interaction (learner-instructor) by <math>r = -.292(-.135 \text{ when the effect of other independent variables is under control). As a result of the multiple regression analysis, the regression equation that predicts the academic achievement of the participants is as follows:$

Academic Achievement = (-0.106 x negative evaluation [learner-learner]) + (-0.108 x avoidance of interaction [learner-instructor]).

Findings Regarding the Third Sub-goal

Table 5 shows the t-test results conducted to reveal whether the participants' mean scores for the sub-dimensions of avoidance of interaction, negative evaluation, and somatic symptoms differ significantly by gender.

	Dimensions	Gender	Ν	Mean	Std. Dev.	t	df	р	
Learner-Learner	Nagativa Evaluation	Female	274	3,76	1,56	2 365	400	018	
	Regative Evaluation	Male	218	3,42	1,60	2,305	490	.018	
	Sometic Symptoms	Female	274	3,62	1,69	2 0 1 4	490	004	
	Somatic Symptoms	Male	218	3,18	1,66	2,914		.004	
	Avaidance of Interaction	Female	274	3,61	1,63	1.016	490	056	
	Avoidance of interaction	Male	218	3,33	1,60	1,910		.050	
	Nagative Evolution	Female	274	3,75	1,69	2 2 1 2	400	021	
	Regarive Evaluation	Male	218	3,39	1,70	2,515	490	.021	
Learner-Instructor	Competio Competence	Female	274	3,57	1,82	2 402	400	017	
	Somatic Symptoms	Male	218	3,18	1,80	2,405	490	.017	
	Amidanas of Internetion	Female	274	3,42	1,67	1 4 4 5	400	1.40	
	Avoidance of Interaction	Male	218	3,20	1,63	1,445	490	.149	

Table 5. T-test results by gender

As can be seen in Table 5, the mean scores of the participants in the negative evaluation and somatic symptoms sub-dimensions differed significantly by gender. Accordingly, it can be claimed that women have higher social anxiety levels compared to men in their interactions with both other learners and the instructor. The scores obtained from the avoidance of interaction sub-dimension did not result in a significant difference by gender. The scores of women and men in the avoidance of interaction sub-dimension were close to each other. Hence, gender did not create a significant difference in the avoidance of interaction sub-dimension in the interaction of the participants with both other learners and the instructor.

The results of the one-way ANOVA test, which was conducted to reveal whether the participants' mean scores for the sub-dimensions of negative evaluation, somatic symptoms, and avoidance of interaction differ significantly by grade level, are presented in Table 6.

tion*	Grade level	Ν	М	S	Source of Variance	Sum of Squares	df	Mean Square	F	р
/alua	1	112	3,86	1,61	Between Groups	31,657	3	10,552		
ive Ev	2	122	3,85	1,54	Within Groups	1214,359	488	2,488	4,241	,006
gat	3	148	3,27	1,55	Total	1246,016	491			
Ne	4	110	3,56	1,60		,				
ms*	Grade level	Ν	М	S	Source of Variance	Sum of Squares	df	Mean Square	F	р
ymptc	1	112	3,63	1,70	Between Groups	28,476	3	9,492	2 2 4 9	010
atic S	2	122	3,67	1,68	Within Groups	1383,521	488	2,835	3,348	,019
шс	3	148	3,09	1,62	Total	1411,997	491			
Ň	4	110	3,40	1,73						
Avoi danc	Grade level	Ν	М	S	Source of Variance	Sum of Squares	df	Mean Square	F	р

Table 6. One way ANOVA results by grade level.

	1	112	3.75	1.66	Between	36.025	3	12.008		
	•		0,70	1,00	Groups	00,020	U	12,000	4.655	.003
	2	122	3,74	1,58	Within	1258,904	488	2,580	1,000	,005
	3	148	3,12	1,55	Total	1294,929	491			
	4	110	3,43	1,64						
* *	Grade	NT	м	C	Source of	Sum of	16	Mean	Б	
ion	level	IN	M	3	Variance	Squares	dī	Square	Г	р
luat	1	112	3 84	1 72	Between	33 422	3	11 141		
iva	1	112	5,01	1,72	Groups	33,122	2		3 903	009
veE	2	122	3,82	1,63	Within Groups	1393,084	488	2,855	5,705	,005
ati	3	148	3 22	1 65	Total	1426 506	491			
leg	4	110	3 56	1 75	Iotui	1120,000	171			
*	Grade	110	0,00	1,70	Source of	Sum of		Mean		
ns*	level	Ν	М	S	Variance	Squares	df	Square	F	р
tor	1	1 1 2	2 (0	1.07	Between	42.007	2	14.400		
du	1	112	3,68	1,87	Groups	43,227	3	14,409	1 120	004
$\mathbf{S}\mathbf{y}$	2	100	2 60	1 70	Within	1595 000	100	2 2 4 9	4,436	,004
tic	2	122	3,08	1,70	Groups	1363,090	400	3,240		
ma	3	148	2,99	1,70	Total	1628,317	491			
So	4	110	3,35	1,87						
	Grade	N	м	S	Source of	Sum of	df	Mean	F	n
۰ <u>۴</u>	level	19	101	5	Variance	Squares	ui	Square	1	Р
n*:	1	112	3 55	1 70	Between	28 240	3	9/13		
anc	1	112	5,55	1,70	Groups	20,240	5),415	3 172	016
oid Srae	2	122	3 54	1.60	Within	1322 990	488	2 711	5,772	,010
Avc inte	4	1 22	5,5 1	1,00	Groups	1522,770	100	2,711		
1	3	148	2,99	1,59	Total	1351,230	491			
	4	110	3,31	1,69						

Note. *= Learner-Learner, **= Learner-Instructor, 1= freshman, 2= sophomore, 3= junior, 4= senior

The analysis results demonstrated that the mean scores obtained from the three sub-dimensions for the theme of learner-learner interaction differed significantly in terms of the grade levels of the participants. Scheffe test results revealed that juniors had less social anxiety for the sub-dimensions of negative evaluation and avoidance of interaction in e-learning environments compared to freshmen and sophomores. Sophomores are more socially anxiety scores of the participants in the avoidance of interaction sub-dimension for the learner-instructor theme did not differ significantly by grade level. The results of the Scheffe test for the other two subdimensions showed that juniors had less social anxiety in e-learning environments compared to freshmen and sophomores. **Findings Regarding the Fourth Sub-goal**

The results of the Pearson product-moment correlation analysis conducted to reveal the relationship between selfefficacy perceptions of using computers and the sub-dimensions of learner-learner and learner-instructor themes are submitted in Table 7.

	Variable	1	2	3	4	5	6	7
Learner-Learner	1 self-efficacy to use pc	1	-,242**	-,219**	-,197**	-,202**	-,212**	-,176**
	2 negative evaluation		1	,712**	,717**	,656**	,588**	,683**
	3 somatic symptoms			1	,677**	,597**	,732**	,652**
	4 avoidance of interaction				1	,723**	,683**	,653**
	5 negative evaluation					1	,706**	,705**
Learner-Instructor	6 somatic symptoms						1	,673**
	7 avoidance of interaction							1

Table 7. Correlation coefficients

Note. **p<.01

It can be claimed that the participants' social anxiety levels are moderate. As can be seen in Table 7, there are negative and low-level significant relationships between self-efficacy in using a computer and the sub-dimensions of the social anxiety scale. Accordingly, it can be alleged that if the self-efficacy levels of the participants in using
a PC increase, their social anxiety levels in e-learning environments will decrease. Highly significant positive correlations do exist between the sub-dimensions of both learner-learner and learner-instructor themes of the social anxiety scale.

Discussion and Conclusion

This study aimed to establish the degrees of social anxiety that prospective teachers experience when working in online learning environments and to shed light on the situation as it currently stands in terms of specific aspects. As a result, the study determined that the participants had a moderate level of social anxiety in their interactions with other learners and the instructor in e-learning environments. This result is basically what is predicted to happen. This may have been due to the unprepared involvement of the participants in the process, their lack of previous experience in e-learning environments, and most importantly, the setting excluding the potential for socialization contrary to human nature. In their study with university students in the e-learning process, Hoque et al. (2021) found that the majority of the students (82,5%) experienced a moderate level of anxiety which was predicted by gender, father's level of education, family size, residence, academic achievement, type of housing and access to high-speed internet. Similarly, Islam et al. (2020) noted that the majority of students (87,7%) had a moderate level of anxiety in another study conducted with university students. It was presumed that the uncertainties about educational processes may have been negatively affected by the high number of cases worldwide and students' anxiety levels about their health with their families (Durgun et. al., 2021). Unlikely, Cao et al. (2020), in their study with university students, did not report any signs of anxiety for the vast majority of students (75,1%) during the COVID-19 pandemic. Díaz-Jiménezet al. (2020) also did not find any signs of anxiety in most students during the pandemic. Undoubtedly, diverse and complex factors cause social anxiety (Prendergast, 2021). These may be due to individual differences, country-place-region differences, culture, environmental factors, income, socioeconomic status, technological equipment, internet infrastructure, and familial background (Ajmal & Ahmad, 2019; Díaz-Jiménez et. al., 2020; Fawaz & Samaha, 2021; Hoque et al., 2021; Kocaman & Ersoy, 2021).

Another prominent result of the study is that participants' social anxiety levels in their interactions with other learners and the instructor in e-learning environments significantly predicts their academic achievement. Accordingly, it can be alleged that there is a negative relationship between social anxiety levels in e-learning environments and academic achievement, and social anxiety harms learning outcomes. Many studies have emphasized that social anxiety may impair the academic achievement of university students (Brook & Willoughby, 2015; Russell & Topham, 2012). Recent studies have shown that the experience of e-learning anxiety significantly affects academic achievement (Saadé et al., 2017; Ajmal & Ahmad, 2019). Hence, it is possible to come across a great deal of evidence in the literature that anxiety affects achievement negatively, and positive attitudes affect academic achievement affirmatively (Arslan & Korkmaz, 2019). It is predictable for students with high academic achievement to have low levels of social anxiety. It has been revealed that students with low performance during e-learning have higher social anxiety levels than those with high performance (Alsudais et al., 2022). Sübaşı (2007) also found that social anxiety badly affects students' academic achievement in her study with university students. The study conducted by Al-Hazmi, Sabur and Al-Hazmi (2020) revealed that there is a significant negative relationship between the social anxiety levels of medical students and their academic performance. It is necessary to reduce students' anxiety towards interaction and increase their positive attitudes toward distance education to improve their achievement in distance education (Arslan & Korkmaz, 2019). It can be alleged that the self-efficacy and attitude levels of prospective teachers towards distance education, their perceptions regarding the learning environment, and their opinions are crucial to being successful in distance education (Haciomeroğlu & Elmali-Erdem, 2021). Although there are varying findings, most studies evidence that anxiety is a negative predictor of academic performance (Tzafilkou, Perifanou & Economides, 2021). Nevertheless, some other university students found that social anxiety does not predict academic achievement (Heckel & Ringeisen, 2019; Çağlar, Dinçyürek & Arsan, 2012; Temizel, 2014). It may stem from individual factors, divergent psychological conditions, expectations, and needs.

Considering the relationship between the genders of the participants and their social anxiety, it can be asserted that women have higher levels of social anxiety compared to men in their interactions with both other learners and the instructor for the sub-dimensions of negative evaluation and somatic symptoms. The mean scores obtained from the avoidance of interaction sub-dimension did not differ by gender. Gender is a significant variable in e-learning environments, and students' anxiety may vary according to their gender (Fawaz & Samaha, 2021; Durusoy, 2019; Roberts, Hart, Coroiu & Heimberg, 2011; Wongwatkit et al., 2020). As a result of a study on university students, Bahçekapılı (2021) found that female students experienced significantly more social anxiety than male students in e-learning environments. Some studies on university students have determined that the gender factor is in a significant relationship with the level of social anxiety, and the anxiety level of women is higher than that of men (Durusoy, 2019; Küçük, 2019; Wang, Zhao & Zhang, 2020). Women may experience

more anxiety than men due to some genetic, biological, and social factors (McLean & Anderson, 2009). On the other hand, the researchers stated that it might be caused by the different expectations of society from men and women and the conventional wisdom that women are shyer than men (Şıngır, Ayvaz & Tonga; 2021). Therefore, the cultural expectation of collectivist societies that women should be humble, quiet, and dignified could potentially justify these results (Alsudais et al., 2022; Karakitapoglu-Aygun & Olcay-Imamoglu, 2002). On the other hand, it is not certain to what extent gender affects anxiety in e-learning environments (Bahçekapılı, 2021). Studies concluded that gender does not cause a significant difference in social anxiety (Aune & Stiles 2009; Ayberk, 2011; Al-Hazmi, Sabur & Al-Hazmi, 2020; Bayraktutan, 2014; Cao et al., 2020, Hakami et al., 2018). On the other hand, some studies in the literature indicate that men's social anxiety levels are higher than women's, unlike our results (Ateş, 2015; Elhadad et al., 2017; Noyan & Berk, 2007). Considering all these, it can be asserted that social anxiety in e-learning environments does not reveal consistent results in terms of gender. The primary reason for this is the behaviour patterns that societies impose on gender.

As for grade levels, it was observed that students with low-grade levels experienced relatively more social anxiety in their interactions with both other learners and the instructor. This study result is associated with the fact that freshmen's insufficient knowledge in theoretical and applied courses, lack of distance education experiences, and loose friendship relations. Similarly, Ağırtaş and Güler (2020) determined that there is a significant difference between the social anxiety levels of undergraduate students in terms of grade level. As a result of the study, it was yielded that the social anxiety levels of the students differed significantly depending on the grade levels, and the social anxiety level of the freshmen was higher than that of juniors and seniors. These results may stem from the recent departure of freshmen from high school they have been accustomed to and their recent move to the university (Paul & Brier, 2001). Similarly, Khoshaim et al. (2020) concluded that students in the last years of university education have lower anxiety levels than students in lower grades. They pointed out that upper-class students are less affected by e-learning. In other words, the closer the students are to their future lives and the shorter their student life is, the less they are affected by e-learning and the lower their anxiety level is. Unlike our results, Aktan (2018) determined that there was no significant difference between the grade level of the participants and their social anxiety as a result of a study conducted with university students. Similarly, Wang, Zhao, and Zhang (2020) found that there is no significant relationship between grade level and anxiety in the elearning process. On the other hand, Al-Hazmi, Sabur and Al-Hazmi (2020) yielded that the students with higher grade levels have less social anxiety compared to students at the beginning of their academic life. Thus, it can be claimed that the students become more familiar with e-learning environments, so their social anxiety levels get lower with higher grade levels.

A negative correlation was found between the participants' self-efficacy in using computers and their social anxiety. The fact that participants can use computers independently may reduce their self-confidence-based social anxiety. In our age, the use of digital tools and equipment is not only a necessity, but it can also eliminate anxiety by giving individuals self-confidence. The level of self-efficacy towards computer use and the perception that using a computer is easy significantly affect online learning applications and the level of anxiety in these learning environments (Saadé & Kira, 2009). Bahçekapılı (2021), in his study, revealed that there is a low level of negative correlation between students' digital literacy levels and social anxiety levels in coordinated courses in e-learning environments. In other words, students' digital literacy knowledge and digital skills increase as their social anxiety decreases in online courses. Self-efficacy for online technologies (Haciömeroğlu & Elmali-Erdem, 2021) as one of the leading factors in distance education is also important in e-learning environments in terms of certain technical issues such as accessing lessons, controlling camera and microphone, and using chat. On the other hand, self-insufficiency toward digital technologies can be attributed to the lack of technological and technical skills leading to social anxiety (Bahçekapılı, 2021). Therefore, the belief that an individual will make fewer mistakes as s/he gains experience in e-learning environments reduces the possibility of negative evaluation by others, reducing social anxiety in e-learning environments. The use of technology and digital tools in the e-learning process serves as the basis for disseminating knowledge (Vaona et al., 2018). From a social learning perspective, self-efficacy helps to reduce social anxiety in web-based learning environments (Hill et al., 2009). Alsudais et al. (2022) pointed out that factors potentially related to the e-learning environment, such as technical background and computer selfefficacy in the learning environment (Chiu & Wang, 2008), will also affect students' level of social anxiety in elearning. Students with high e-learning self-efficacy perceive more contextual control when dealing with any online platform, are more interested in mastering learning and technology-related challenges, are more willing and motivated and experience lower anxiety levels (Heckel & Ringeisen, 2019). In addition to the self-efficacy of using a computer, an internet connection is a must in distance education to be included in online environments. As a result of their study, Hoque et al. (2021) revealed that students who do not have a high-speed internet connection feel more anxious in e-learning environments.

As a result of the present study, which was conducted to reveal the current situation regarding certain variables by determining the level of social anxiety of pre-service teachers in e-learning environments, it was found that pre-service teachers had a moderate level of social anxiety in e-learning environments, and the level of social anxiety negatively affects academic performance. In addition, the gender of pre-service teachers was found to have no direct effect on social anxiety in e-learning environments, but their grade level was critical to social anxiety. Furthermore, a direct relationship was found between prospective teachers' self-efficacy in using computers and their social anxiety in e-learning environments. Studies in the literature have yielded parallel or different results to the present study. Since these studies were conducted in different countries/regions, social, cultural, and economic factors may have had an influence.

Recommendations

Given the results obtained, it is necessary to incorporate practices that ensure moderate levels of social anxiety and positive attitudes toward e-learning in order to increase the level of student achievement in distance education e-learning environments.Students should be encouraged to actively participate in the lesson by turning on audio and video during the lessons. Applications should be developed that will allow students to interact with their friends and instructors during synchronous lessons. Appropriate strategy-method-techniques should be adopted in synchronous lessons for instructor-learner interaction and learner-learner interaction, and e-learning should be supported by a face-to-face learning environment if necessary. Technical support and training should be provided so that students can actively use technological devices such as computers and tablets. Administrative bodies should collaborate with universities to provide students with rapid and accurate psychological support. To ensure that students continue to participate in the educational processes, universities should develop comprehensive online-based education programs in collaboration with internet service providers. These programs should be designed to reach students residing in remote areas, regardless of whether or not the students have access to a device.

Authors Contribution Rate

The authors contributed equally to the paper.

Conflicts of Interest

Authors declare that they have no conflict of interest.

Ethical Approval

Ethical permission (2022-SBB-0163) was obtained from Bartin University Social and Human Sciences Ethics for this research.

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Are Primary Teachers Literate or Not: A Study on Curriculum Literacy of Primary Teachers

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Are Primary Teachers Literate or Not: A Study on Curriculum Literacy of Primary Teachers

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Abstract

This study aims to investigate the curriculum literacy levels of primary teachers. The study group of this study, which is based on a case study from qualitative research designs, consists of teachers working in primary schools in the 1st term of the 2020-2021 academic year in Diyarbakir. The teachers in the study group were selected by criterion sampling, one of the purposive sampling methods. The semi-structured interview technique was used in the data collection process of the research. In addition, the qualitative data obtained were analyzed with descriptive analysis methods. As a result of the analysis, it was revealed that the primary teachers did not directly access the curriculum designed by the MoNE but indirectly followed the curriculum by downloading the annual plans from the web pages on the internet. In addition, interviews with teachers revealed that they could barely demonstrate the philosophy, values, and competencies in the curriculum and were not aware of these parts. On the other hand, primary teachers stated that they focused on basic skills (reading, writing, and arithmetic), life skills (selfconfidence, entrepreneurship, self-regulation, problem-solving), and values education (love, respect, honesty, sharing, and responsibility) in success. It is seen that while teachers mostly talk about the acquisitions related to basic skills, life skills, and values education in the curriculum, they refer less to the acquisitions of related mathematics and engineering skills, which are widely used and vital in today's world. This result showed that they care about the inclusion of skills, life skills, and values education in the curriculum, and they try to achieve the goals for these skills by the students.

Keywords: Curriculum, Primary School Teacher, Curriculum Literacy

Introduction

The concept of literacy was a skill to be gained by newly beginner students of primary school in traditional education. However, it is now frequently mentioned in different fields of educational study. The concept of literacy was initially expressed as the ability to gain reading and writing skills (Dictionary of Turkish Language Institution [TDK], 2020) and to analyze symbols expressed in written language (Kurudayıoğlu & Tüzel, 2010), while it is now an important skill that affects not only the individual but also the whole society (Raja, 2005).

With the change in life conditions, scientific and technological developments, and the emergence of additional needs, the meaning of the concept of literacy has deepened, and its framework has diversified (Aşıcı, 2009). The definitions of literacy made by UNESCO at different times in fifty years easily show how much the concept has changed. For example, in 1958, UNESCO defined the concept as a person who can both read and write a short and simple statement about his/her daily life. In 1978, UNESCO defined it as someone who can engage in all activities in which literacy is necessary for the effective functioning of his group and community and continues to use reading, writing, and calculation skills for the development of society. In 2005, it defined literacy as the ability to describe, understand, interpret, create, communicate and calculate using printed and written materials related to various contexts.

As seen, literacy is a concept that has been defined differently throughout its historical past (Barone, 2015), and in line with the different social needs, various kinds of literacy for individuals have appeared in different fields following the 2000s (Grisham & Wolsey, 2006). In this century, the concept of literacy is particularly highlighted for learners in an educational context as a member of world citizens to have digital literacy, information literacy, health, and environmental literacy skills to cope with the needs of 21st century and life skills (Partnership for 21st Century [P21], 2010). This has changed the approaches in the curriculum prepared for educational systems and has led to the development of curricula that can meet the current needs. However, no matter how well the curricula were designed, they could not show the success and effect they aimed for unless they were correctly and fully

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understood by the teachers who played a key role in the implementation process (Yıldırım, 2019). Penick (1995) stated that the most prominent reason the curriculum could not achieve the desired success was the teachers' commitment to traditional methods in teaching and learning process. The studies in this field have frequently sampled the teachers as the data source in the curriculum (Kurt & Erdoğan, 2015; Ozan & Köse, 2014), teachers emphasized they do not know the curriculasufficiently and need some kind of introduction regarding the curricula they will implement (Çiftçi & Tatar, 2015; Duru & Korkmaz, 2010). Finally, the concept of curriculum literacy was brought to the agenda as a solution, and this concept was also included in the curriculum of teacher training institutions updated on May 16, 2018 (Higher Education Council [HEC], 2018).

Review of Literature

Curriculum Literacy as a Term

The concept of curriculum literacy was first put forward by Akınoğlu and Doğan (2012) in the literature, then was conceptualized by putting forward that the differences in the application of curriculum stem from the teachers' ability to understand, perceive, interpret and implement the curriculum differently. Yıldırım (2019) defined curriculum literacy as the ability of practitioners to reach a correct mindset by asking "Why, What, How, and How Much" questions while examining the curricula. Kahramanoğlu (2019) defined curriculum literacy as the process of making sense of and analyzing the official curriculum using teachers'high-level mental skills. Akyıldız (2020) considered curriculum literacy as the competence to understand, implement and evaluate the curriculum developed in a field. Keskin (2020) expressed curriculum literacy as the teacher's knowledge regarding the features and use of curriculum in practice, using the curriculum as a guide by making critical evaluations and interpretations. Erdamar (2020), on the other hand, defined curriculum literacy as teachers' ability to know and implement the curriculum, and it is a qualification that all education stakeholders should have to adapt to the 21st-century learning approaches. As seen from its various definitions, curriculum literacy requires teachers both appropriate knowledge and use of the curriculum and its features.

The Function of Curriculum Literacy in Education

The concept of curriculum literacy has two important functions in the educational process. The first of these is that it helps curricula designed with great effort and time to achieve desired goals (Olivia, 2009), which determines the quality of education. Although curricula serve as a guiding resource that teachers implement on certain days and times of the week (Bulach, 2002), each teacher can implement the program as much as he/she understands and adopts it (Ryu, 2015). For this reason, no matter how perfectly a program is designed, it needs to be understood appropriately by the implementers to implement it correctly (Akyıldız, 2020; Ellis, 2013; Park, 2008). The related literature shows the existence of teachers using the same curriculum but implementing it in different ways (Bümen et al., 2014; Gallagher & Tobin, 1987; Songer & Gotwals, 2005), and even some teachers manage the teaching process with traditional methods by resisting changes and updates made in curricula (Penick, 1995). It is also noted that as one of the main variations of the teaching and learning process, teachers have problems in possessing the skills and competencies they need to truly understand, perceive, and implement the curriculum (Süral & Dedebali, 2018).Based on these results, teachers should plan the educational process by understanding the curriculum's structure, philosophy and essence to implement it in the targeted way (Akınoğlu & Doğan, 2012); that is, they should be well-literate.

The second function of curriculum literacy is to contribute to curriculum development and evaluation studies. Curriculum development in education is a dynamic process in which necessary revisions are made as educational programs are designed, developed, tested, implemented, and evaluated (Erden, 1998; Gürkan, 2005; Özdemir, 2009).Curriculum development in education is a process carried out in cooperation with all stakeholders in order to change and improve the curriculum in terms of quality (Marsh & Willis, 2007). Curriculum development requires a continuous process because the designed curriculum cannot be complete unless it is implemented (Varis, 1996). Therefore, an evaluation of the designed curriculum is required. Curriculum evaluation is needed to determine whether the designed curriculum has achieved the desired goals and criteria during its implementation and to provide reliable feedback to decision-makers about the existing problems or utilities of the curriculum (McCain, 2005; Morrison, 1993). The studies on curriculum development and evaluation in Turkey have shown that the curricula implemented after the design process are regularly evaluated, certain decisions are made in this direction, and the programs are eventually renewed (MoNE, 2006-2010-2018). Also, these studies mostly included teachers as the study group (Gündoğdu & Dönmez, 2016; Kozikoğlu & Senemoğlu, 2015; Kurt & Erdoğan, 2015; Ozan & Köse, 2014). However, the relevant literature shows that teachers mostly do not have adequate information; they do not know the programs well enough and need a certain introduction regarding updated curricula (Çiftçi & Tatar, 2015; Duru & Korkmaz, 2010; Kaymakçı, 2015; Şimşek, 2017; Kahramanoğlu,

2019). In this case, as the most preferred study group in curriculum evaluation studies, the teachers express their opinions about the programs that they do not have sufficient knowledge and use and risk the reliability and validity of the relevant studies. Based on these views, knowing the curriculum literacy levels of teachers may contribute both to the desired success of the curriculum and to the development and evaluation studies. As Ariav (1991) noted, knowledge of curriculum development approaches and correct application of the curriculum is related to the level of curriculum competence of teachers.

Curriculum Literacy Studies in Turkey

The related literature shows that there has been a trend in the subject of curriculum literacy in the last five years, and scientific research have focused on this subject. The preliminary studies in this field aimed to develop a reliable and valid measurement tool to measure the curriculum literacy of teachers, school administrators, and teacher candidates (Akyıldız, 2019; Bolat, 2017; Karataş, 2020; Yar Yıldırım & Dursun, 2019; Yar Yıldırım, 2020; Yıldırım, 2019). Following studies, Erdem & Eğmir (2018), Kana et al. (2018), Çetinkaya & Tabak (2019), and Süral & Dedebali (2018) examined the curriculum literacy levels of pre-service teachers and concluded that pre-service teachers consider themselves sufficient in terms of knowledge and use of curriculum designed. Aslan (2018), Kahramanoğlu (2019), Erdamar (2020), and Keskin (2020) examined the curriculum literacy levels of teachers working at various school stages and concluded that the teachers had a high level of curriculum literacy. The common point in these studies is that they were based on quantitative methods, and the curriculum literacy levels of teachers and pre-service teachers were measured with 5-point Likert scales. Therefore, the related literature needs studies dealing with teachers' curriculum literacy from a different and deeper perspective. To add, the relevant literature points out that on the one hand, teachers have a high level of curriculum literacy, on the other hand, they feel inadequate and need knowledge and introduction of the curriculum they will implement. Based on these contradictory results, we need to get more detailed and in-depth analyses of teachers' curriculum literacy by interviewing the teachers individually. In addition, this study planned to deal with the curriculum literacy of primary school teachers who implement at least three curricula each year total 11 curricula belonging to different study fields throughout the four years teaching process in primary school. Primary teachers implement the curriculum of a variety of disciplines like Turkish Language, Mathematics, Music, Visual Arts, Physical Education, and Game Courses, Information Technologies and Software from the 1st grade to 4th grade, while they implement a curriculum of Life Science (1st, 2nd, 3rd grades), Social Studies (3rd and 4th grade), Science (3rd and 4th grade), Human Rights and Citizenship (4th grade), Traffic Safety (4th grade) at certain grade levels in Turkey (MoNE, 2018). Based on this, this study aimed to examine the curriculum literacy of primary teachers along with the following research questions:

1. How do primary teachers access to curricula designed by MoNE?

2. What do primary teachers know about the perspectives of curricula designed by MoNE?

3. Do the primary teachers find the curricula designed by MoNE up-to-date or not? In which parts?

4. What areas and skills do primary teachers emphasize most when implementing curricula designed by MoNE?

5. Which methods and techniques do primary teachers mostly use to help students to achieve the aims of curricula?

6. What kind of assessment and measurement techniques do primary teachers mostly use to assess students' achievements?

Method

Research Design

This study was based on a case study, one of the qualitative research designs. The case study is based on deep foundations and tries to describe events that occur in their natural environment at a determined time and place with the help of various data collection tools (Hancock & Algozzine, 2006). With this design, a single situation or event is examined in depth longitudinally, data is collected systematically and what happens in the real context is searched (Subaşı & Okumuş, 2017). This study adopted a descriptive case study, which is one of the case studies put forward by Yin (2003), since the descriptive case study describes the phenomenon revealed in previous studies and allows the description and conceptualization of the key concepts and subsets of the examined phenomenon (Ozan-Leymun et al., 2017).

Participants

The study group of this research included teachers working in primary schools in the 1st term of the 2020-2021 academic year in Diyarbakir. Teachers in the study group were selected with criterion sampling, one of the

purposive sampling methods. A basic feature of the criterion sampling method is to study all cases that meet a predetermined set of criteria, which can be determined by the researcher or a pre-determined list (Yıldırım & Şimşek, 2013). In this study, the fact that the primary teachers have taught in all four levels of primary school (1st, 2nd, 3rd, and 4th grades) was used as a sampling criterion. 20 primary teachers were sampled by criterion sampling method for the interviews, and their demographic characteristics were presented in Table 1.

Participant	Gender	Age	Experience	Educational level	Department	The school setting
T1	F	32	12	Bachelor's degree	Mustafa Kemal University Education Faculty	District
T2	F	35	10	Bachelor's degree	Siirt Education Faculty	District
T3	М	31	6	Bachelor's degree	Ziya Gökalp Education Faculty	District
T4	F	26	4	Bachelor's degree	Hacettepe Education Faculty	District
T5	М	37	15	Bachelor's degree	Ziya Gökalp Education Faculty	City Center
T6	М	35	12	Bachelor's degree	Bayburt University Education Faculty	District
T7	М	34	12	Bachelor's degree	Siirt Education Faculty	District
T8	М	37	14	Bachelor's degree	Siirt Education Faculty	District
T9	М	36	14	Bachelor's degree	Siirt Education Faculty	City Center
T10	М	35	12	Bachelor's degree	Siirt Education Faculty	District
T11	F	45	24	Bachelor's degree	Abant İz. Baysal University Education Faculty	City Center
T12	F	39	15	Bachelor's degree	Siirt Education Faculty	City Center
T13	F	40	16	Bachelor's degree	Abant İz. Baysal University Education Faculty	City Center
T14	F	39	16	Bachelor's degree	Siirt Education Faculty	City Center
T15	М	37	10	Bachelor's degree	Abant İz. Baysal University Education Faculty	District
T16	F	30	9	Bachelor's degree	Ziya Gökalp Education Faculty	District
T17	М	29	6	Master	Ziya Gökalp Education Faculty	City Center
T18	F	37	15	Bachelor's degree	Marmara University Education Faculty	City Center
T19	М	30	7	Master	Giresun University Education Faculty	District
T20	М	36	10	Bachelor's degree	Siirt Education Faculty	District

Table 1. Demographic characteristics of participant primary teachers.

Table 1 shows the distribution of participant teachers by gender, age, teaching experience, education level, the department they graduated, and the school setting. As shown, nine of the participants were female and eleven were male; the age of four teachers was 30 and below, fifteen teachers were between 31-40 and one teacher was 41 and over. Seven teachers had 0-10 years' experience, twelve teachers had 11-20 years' experience, and one had 20 years or above teaching experience. Additionally, eighteen teachers had undergraduate degrees, and only two teachers had master's degrees. Eight teachers graduated from Siirt University Education Faculty, four teachers from Dicle University Ziya Gökalp Education Faculty, three teachers from Abant İzzet Baysal Education Faculty,

and one from Mustafa Kemal University Education Faculty. Finally, eight of the teachers worked in the city center and twelve were in the district.

Data Collection Process

In this study, a semi-structured interview technique was used. Semi-structured interviews provide the interviewees with the option to express themselves and provide in-depth information in the relevant field (Büyüköztürk et al. 2016). In order to serve this purpose, interview questions were prepared to determine the curriculum literacy levels of primary teachers. The draft questions were sent to the three experts in the field and required revisions were made in line with the feedback. After that, the questions were directed to three primary teachers, and it was confirmed that they served the purpose. The questions were as follows:

- ▶ How do you access to curriculum? Which web page?
- > What do you know about the philosophy adopted in the curricula?
- > What is the general aim of the curricula you use? And is it up to date or not?
- > What skills, learning areas and values are emphasized in the curricula of primary schools?
- What kinds of aims are emphasized in curricula? Which one do you mostly help students to gain and why?
- Which teaching and learning methods are offered by the curricula, which one do you mostly use in the process and why?
- What kind of assessment and measurement methods and techniques are offered by the curricula, which one do you mostly use in process and why?

For the interviews, appropriate teachers for the criteria were contacted, and an appointment was arranged for the interviews with the volunteers. Then, on the appointment day and time, a link was sent to the teacher via the contact address to interview online. At the beginning of the interview, the participant teachers' consent was taken to record the online interview process. Then participant teachers were informed orally and loudly by the researchers about the scope, purpose, the use of data through the study, and their withdrawal right from the study. After that, interview questions were directed to participant teachers one by one. During the process, the same questions were directed to the teachers in the study group and enough time and opportunity were granted to express themselves. The questions were directed in different ways, without spoiling the meaning, so the teachers could easily understand and answer them.

Data Analysis

The qualitative data obtained in this study were analysed with descriptive analysis methods. The data is summarized and interpreted in the descriptive analysis according to pre-determined themes (Yıldırım & Simsek, 2013). In this study, 20 teachers were interviewed for 6 hours, 16 minutes and 18 seconds; on average, each teacher was interviewed for 19 minutes. The shortest interview lasted 10 minutes, and the longest one 31 minutes. Afterward, the interviews were listened to again and again by the researchers, transcribed to word format, and 68 pages of data were obtained.

Validity and Reliability

Creswell & Miller (2000) stated that the research paradigm significantly influences the choice of validity and reliability criteria. Batch and Oral (2021) stated that validity and reliability studies in qualitative research, unlike quantitative research, focus on situations such as what the events mean and how the experiences are interpreted. Guba and Lincoln (1994) mentioned the concept of reliability for the concepts of validity and reliability in qualitative designs. Based on the views as mentioned above, this study focused on *internal validity*, which expresses the conformity of the findings with reality; *external validity*, which expresses the generalizability of the research findings to similar situations and participants; and *objectivity*, which expresses the distance and impartiality of the interviewee.

In order to ensure the external validity of the research, the study group, the research process, and the procedures in the process were explained in detail. In addition, the raw data obtained during the process were kept in case of a request for comparisons in the interviews. To ensure internal validity, the findings were processed in detail, and all the findings were directly transcribed to Word format on the PC without comment. To prevent any deviation from the research or subject during the interview process, the questions prepared within the scope of the research were directed to the participants with different expressions to obtain data that would serve the purpose of the research. In order to ensure the reliability of the study, first, the interview data transcribed by the researchers were examined by another researcher to ensure any deficiencies or missing about the recording. Then the data selected over a small sample number were analysed and a codebook was created by the researchers (Kuckartz, 2014). The data obtained from a small part of the data set were coded separately by two researchers, and the reliability between the coders was calculated. The reliability formula suggested by Miles and Huberman (1994) was used to calculate the reliability of the coding [Reliability = Agreement / (Agreement + Disagreement)]. The inter-coder reliability was calculated as .84 in this study.

Results

In this section, the data obtained regarding the research questions were analysed, and the themes were presented in diagrams.

The way of primary school teachers access to curricula

In this part, primary school teachers were asked how and from where they accessed the curricula. As a result of the responses of teachers being analyzed, two main themes were obtained and presented in Figure 1.



Figure 1. The way of primary school teachers to access curricula

As seen in the figure, primary teachers access to curricula in two ways: directly and indirectly. Most of the participating teachers indicated that they indirectly access the curricula and use the annual plans instead of the curricula to achieve the educational goals. The rest of the teachers directly accessed the curriculum to check the annual plans they had downloaded. The views of primary teachers on this question were as follows;

No, I've never check over it. I'm accessing through the annual plans. I usually access the annual plans from the <u>eğitimhane.com</u>, sometimes from the MoNE course webpages. Sometimes, I also check out the <u>siniföğretmeniyizbiz.com</u> page. I check whether my downloaded annual plan is compatible with that year (T2).

I have never check over the curricula. For 12 years, for example, I have never wondered what aims exist in the science curricula and what kind of assessment and evaluation approach it is talking about (T6).

Well, I've never looked into it. I haven't had a chance to review it. I have a smart board to access the aims. I Access the aims via annual plans. There are ready-made templates for the annual plan; we take them and adapt them to ourselves. There are some web pages. I usually download the annual plans from <u>eğitimhane.com</u> (T10).

Primary teachers' knowledge regarding the perspective of curricula

In this part, primary school teachers were directed to questions about the perspectives of curricula and were asked to talk about the curricula' philosophy, values and competences. As result of teachers' responses, three main themes were obtained and presented in Figure 2.



Figure 2. Primary teachers' knowledge regarding the perspective of curricula

In the interviews with the primary teachers, it is seen that only e few of the teachers have knowledge about the perspective of the curriculum (philosophy, values, and competencies of the curriculum). They seem unable to express an opinion or have enough information about the curriculum's philosophical approach and highlighted competencies. However, the teachers seem to have more knowledge about the values in the curriculum than the competencies and philosophical approach. The views of primary teachers on this question were as follows;

I don't believe it has much philosophy. In my opinion, I can say that when the teacher spends his/her time by adding his/her own view and idea and reflecting this to the child, a philosophy is formed (T2).

The student is passive, the teacher is active, and everything is built on it. The curriculum does that. We have these in our curricula; however, rarely implemented (T5).

I can say this because I have always worked in the village. The level is pretty bad, it's not constructivism or progressivism, and this is not something I take into account (T6).

Primary teachers views on the current status of the curricula

In this part, primary school teachers were asked questions about the current state of the curriculum and were asked to explain the reasons for their views. As a result, responses from the teachers were analysed and presented under two major themes in Figure 3.



Figure 3. Primary teachers' views on the current status of the curricula

The interviews with the primary teachers showed that, while some teachers consider the curricula compatible with today's world, some do not. The figure pointed out that primary teachers think curricula are up to date as they highlight communication, questioning, and problem assessment skills, values, and environmental awareness, as well as they are consistent with the principle of vitality and scientific developments. However, those teachers do not consider the curricula up to date because of their being far from the cultural structure and today's world, as well as not considering individual differences, not being technology-based and accessible, and having an excess of abstract concepts. In addition, some teachers stated the curriculum is heavy, and this cause problems regarding timing in the implementation process; therefore, they do not think the curricula are in harmony with today's world. The views of primary teachers on this question were as follows;

I don't think it's compatible. For example, I see that in the 21st century, science technology, laboratories, coding, and especially such applications are still not made in MoNE schools. Therefore, I do not see it as consistent (T6).

In fact, if I am not mistaken, critical thinking, productivity, and social and cultural skills are included in the curricula. The Turkish course I said, includes more learning aims. Since the number of both weekly course hours and educational aims in mathematics is limited, there are aims for critical thinking and problem-solving skills. I think they are included in the curricula, but I am unsure if we can implement them properly. We try to do it in a compressed way because the curriculum is intense. We are trying to implement the whole curriculum but we are experiencing difficulties, we cannot concentrate (T13).

In fact, we can say that it is compatible with today's world. However, since we have many students and parents who cannot keep up with today's world due to some problems arising from the individual development of children, socioeconomic level, environment, culture, family structure, and the school structure, we naturally have difficulties. Since the curricula are sent from a certain center to the entire country, unfortunately, not every student in the school can live at the same level due to certain impossibilities. In this respect, we also feel deficient. For example, a curriculum in the city center may not be the same as a curriculum in a village school. I think it would be better if it was not the same. In addition, it can be a little difficult to implement the same curriculum in every school in a city center because the curriculum to be implemented to students with high socio-economic or cultural levels and those to be implemented in schools with a low level of consciousness needs to be slightly different, that is, the curriculum would be more useful if it is designed according to student level and individual differences (T17).

Primary school teachers' views regarding the educational aims of curricula

In this part, primary school teachers were asked questions about the educational objectives of the curricula, and they were asked to share their views on the knowledge, skills, and behaviors that are emphasized in the curricula and which of them they are trying to teach to students. As a result of the responses of teachers being analysed, four main themes were obtained and presented in Figure 4.



Figure 4. Primary school teachers views regarding the educational aims of curricula

As seen in Figure 4, primary teachers had well awareness regarding basic skills, life skills, and values education but hardly ever about the mathematics and engineering skills targeted in primary schools' curricula. The results of analysis showed that primary school teachers mostly highlighted the reading and writing (T1, T2, T4, T6, T8,

T10, T17) and arithmetic (T1, T4, T6, T8, T17) skills, which showed that they were persistently trying to teach these skills to students. Also, they cared about life skills and values education since they frequently emphasized such skills as entrepreneurship, self-control, problem-solving, communication and thinking (critical, reflective, analytical, and creative thinking). In addition, some teachers (T10, T14) prioritized the love of school rather than the achievement of curriculum aims, while some others just tried to help students to achieve the curriculum aims on time within the learning process. The views of primary teachers on this question were as follows;

Let them learn to read, write, do arithmetics, and be a good person. I care about these (T6).

I want them to understand me and put it into practice. I just don't want them to understand by heart. I taught you something. I would love for themto put what they have learned into practice. But how much is done in practice? It's a debatable topic. What we care about is that the children we teach can get somewhere when they grow up. For this, let the child has love for school. This is enough for us. If the child likes school, I think it will be ok. Since I am a bit prone to mathematics, I focus a lot on mathematical skills. For me, math is at the beginning of everything. A child who understands mathematics thinks more easily and rationally. It is easier for him to grasp. It seems to me that they can do everything. I am in favor of their being more analytical thinkers (T10).

As for me, it is a problem-solving. A child should be able to do his work and solve his problems. Problem solving should be used to produce his own solution to the problem he will encounter in mathematics and his life. A common mistake made children in this period is that parents are actually experiencing a conflict of generations or a conflict in what we call modern life. We try to raise our children with what we hear. Maybe we make the same mistake too. But I want children to be raised so they can do their own work, solve their problems, and ask for help when needed. I am trying to train my students in this direction. They need to look critically (T13).

Primary school teachers' views regarding the teaching and learning process of curricula

In this part, primary school teachers were asked questions about the curricula' teaching and learning process. They were asked to share their views regarding their behaviours and choices for activities suggested in curricula for the achievement of aims. As a result teachers' responses, two main themes were obtained and presented in Figure 5.



Figure 5. Primary school teachers' views regarding the teaching and learning process of the curricula

Figure 5 shows that teachers developed strategies for implementing the teaching and learning process of the curricula in two different ways. While the first of the strategies adopted by the teachers mainly targeted at implementing the constructivist approach and considering the interests and needs of the learners, the second strategy is based on the teacher's subjective point of view. Those teachers adopted the first strategy to take a stance against memorization, use the discovery learning approach, guide learners, emphasize the principle of vitality in learning, adopt social, language and thinking skills, and moral values. In addition, they use technology in the teaching and learning process, adopt a game-based approach, attach importance to concretization, and individual differences of learners, and practice self-control. However, the teachers adopted the second strategy in the curriculum with a subjective approach because they believe that the achievements of aims in the curriculum cannot be possible as the curricula include too much; therefore, teachers experiences burnout and difficulty focusing on or internalizing the achievements. These all lead teachers to adopt a different way of implementing curricula in line with their subjective point of view. The views of primary teachers on this question were as follows;

Generally, teachers feel like going to class, finishing the course, and leave. They have the intention of saving the day. It would be wrong to generalize, but if there are 10 teachers in a school, 2 teachers really do something by tearing themselves apart, adding something from themselves. However, the rest just fill the time. Teachers sometimes make excuses when there is an activity to avoid taking part in it. I do not understand this? For example, they say I would not take part (T2).

Some children have a quick wit, but I teach them individually, but if a child is low to gain the aims, I try to get him/her to gain it by one by. For example, I see that if a student cannot count from 1 to 100, it is sufficient for him/her to count from 1 to 20 (T4).

In order to solve exam questions, the development of reasoning skills, which is the most common problem that I come across, which I also observe with my daughter, and it also appears in the source books too. I often encounter with this. As for me, it is problem-solving and reasoning skills (T18).

Primary school teachers' views regarding the assessment and measurement process of curricula

In this part, primary school teachers were asked questions about the assessment and measurement process of the curricula, and they were asked to share their views regarding their practices and choices for assessment and measurement methods suggested in curricula for testing the achievements of aims. As a result of teachers' responses were analysed, two main themes were obtained and presented in Figure 6.



Figure 6. Primary school teachers' view regarding the assessment and measurement process of the curricula

As seen above, primary schools' teachers use both traditional and alternative assessment and measurement tools in the process. Primary teachers mostly use questioning, rubrics, portfolios, creative story writing, self-assessment, project-based practices, and checklist as alternative assessment and evaluation tools. They use open-ended questions in written and oral examinations, fill-in gaps items, and true-false tests as traditional measurement and evaluation tools. It is also seen that observation technique is the most preferred alternative assessment tool and the test technique is the most preferred traditional assessment and evaluation tool. However, some primary teachers consider it sufficient to know the student during the evaluation process; they do not keep records or only use the evaluation exercises at the end of the textbook. The views of primary teachers on this theme were as follows;

I'm making observations. I ask questions during the course. By doing these, I already know and understand the students. I do not keep a record while making an assessment (T1).

In the first years, I was not doing anything for evaluation. Then three inspectors visited. They came to school every year. There were evaluation tools behind all the books, and they suggested we do these evaluations. After that day, I evaluate according to the evaluation tools at the end of the activity book. I partially used my observations of students' behavior; but now I don't use it. My students don't understand. This is a big trouble. Even if I know the child, I know that I have to evaluate them. For example, I had a student who was a little older than the other children. He did math very well, but I don't know if it was my fault, but he was excited and stuttered in reading. Success in other courses affected the score I would assess in that

course. If he is good at the other courses, he is good at this too. I said he failed because of the excitement. Therefore, I feel the need to make evaluations (T3).

You know, exams are done with paper and pencil, so I think so. I do both oral and written assessments. For example, I always devote one day a week to grammar. I am giving an example of the grammar subject I studied this week from the Turkish course. If I am going to cover another subject in the Turkish course next week, I always try to remind that subject in the first 10 minutes, and I get feedback from the children verbally. Afterwards, at certain intervals, I distribute tests or any worksheets and collect them, or give them as homework, then I collect it and check it, if there are any left behind, I try to give feedback by communicating with the family or informing the child in the classroom. I already evaluate each student on their own. We were preparing evaluation tools for each course according to the achievements of the school subjects at the 1st, 2nd, 3rd grades. Even though there is no exam, the assessment tools we have prepared check for achievement of the objectives in terms of how we will assess students. If the student has achieved that aim, we already give a valid score, but if he does not, we do not evaluate based on comparison like student A is more successful than student B, but we evaluate as if the student has gained that behaviour. We evaluate whether the gain has been achieved or not. I used the evaluation tools in the 1st, 2nd, and 3rd grades, and now there is an exam in the 4th grade (T18).

Results and Discussion

This study, aiming to examine the curriculum literacy of primary teachers, revealed that primary teachers do not directly access the curriculum designed by MoNE but indirectly follow the curriculum by downloading the annual plans from web pages on the internet. The previous studies also concluded that teachers followed the curriculum from textbooks and guidebooks (Karacaoğlu & Acar, 2010; TED, 2009). The other studies in the literature also supported these findings. They concluded that teachers do not follow the MoNE's web pages posting the curricula (Dursun, Bedir, & Gülcü, 2017), they do not change their annual plans unless there is an update or revision in the curriculum (İşman & Eskicumalı, 2003), and even they download their annual plans from the internet or take it from other colleagues (Öztürk, 2012). Here, it wouldn't be wrong to say that teachers make evaluations based on the annual plans for evaluation, fidelity, or literacy studies of the curriculum. It has been emphasized that although annual plans are partially effective in education, their effect is weak, and many of the methods and activities suggested in the plans are actually ignored (Sirinkan & Gündoğdu, 2011). Thus, the curriculum literacy level of primary teachers may not be sufficient. However, it is necessary to know how teachers perceive and understand the curriculum and how they approach the skills and competencies to implement the curriculum (Demir & Toraman, 2021). Curriculum literacy is the ability of teachers to have the knowledge and execute the knowledge about the curriculum (Erdem & Eğmir, 2018). For this reason, teachers need to have a certain level of curriculum literacy to know, implement and develop a curriculum if necessary as a part of fulfilling their professional responsibilities under legal regulations (Yar-Yıldırım, 2020).

Annual plans provide teachers with guidance regarding objectives, the learning and teaching process, and assessment and evaluation components. However, they provide insufficient information about the philosophy, purpose, values, and competencies of the curriculum. One of the most important issues in teachers' recognition of the curriculum is their understanding the philosophy of curriculum (Keskin, 2020). The interviews with the teachers revealed that they can barely point out the philosophy, values and competencies in the curricula and are unaware of these parts. However, curriculum literacy enhances the teachers' ability to perceive the philosophical approach in the curriculum, enables teachers to adopt the approaches in the curriculum more quickly, develop more accurate perspectives towards the curriculum increasing their beliefs towards curriculum (Yılmaz & Kahramanoğlu, 2021). Erdamar and Akpınar (2020) attribute teachers' low theoretical curriculum literacy to their ineffective training process during the pre-service education, to the school culture and curriculum development process in the country. In addition, participants' teachers are also unaware of the innovations and updates in the curricula. This result is consistent with other studies in the literature; the teachers are unaware of the innovations or updates in the curriculum and they stated to be not well informed about the curricula (Ciftçi et al., 2013; Demirtas & Erdem, 2015; Günal & Akdağ, 2021). Therefore, the teachers may think that the curricula are far from today's world and are not up-to-date as they haven't got well information about the curricula and base their own perspectives on the implementation process. This causes teachers to implement the curricula and to choose materials and activities as much as they know (Kahramanoğlu, 2019). Another finding obtained within the study is, primary teachers' behaviors (orienting towards subjective practices, focusing only on achievement) and affective reactions (desire to save the day, inability to internalize the curriculum, etc.) exhibited while implementing the curriculum can be results of this too.

Primary teachers started to focus on the basic skills (reading, writing, and arithmetic), life skills (self-confidence, entrepreneurship, self-regulation, problem-solving), and values education (love, respect, honesty, sharing, responsibility) in the achievement of aims in curricula. It is seen that while the teachers mostly mentioned the achievements related to basic skills, life skills, and values education in their courses, they pointed out less about

the achievements related to mathematics and engineering skills, which are widely used and vital in today's world. This result showed that teachers care about the achievement of 21st-century skills, life skills and values education in curriculum, and attempt to realize the students' aims regarding these skills. Therefore, primary teachers play a critical role in the individual's acquisition of vital knowledge and skills (Celik et al., 2019). However, the participant teachers mostly mentioned learning and innovative skills such as problem-solving, innovation, creativity, and communication within 21st-century skills. Still, they barely mentioned about media and information literacy, flexibility, adaptability, entrepreneurship and productivity, leadership, social and intercultural skills. With the curriculum update made in Turkey in the 2017-2018 academic year, the curriculum highlights 1. Mother Tongue Literacy 2. Physical Education and Sports Competencies 3. Information Literacy 4. Information and Communication Technologies Literacy 5. Science Literacy 6. Human Rights and Democratic Sensitivity Competencies 7 Mathematical Literacy 8. Learning Competencies 9. Self-Awareness 10. Art Proficiency 11. Basic Life Competencies 12. Foreign Language Literacy and Competencies 13. Basic skills such as Knowledge and Consciousness of Citizenship (MoNE, 2018). Also, the studies in the literature showed different results regarding teachers' use of 21st-century skills in curricula. For example, some teachers use moderately (Karabekmez, 2021), and some are high and close to high (Eğmir & Cengelci, 2020; Gürültü et al., 2019; Kıyasoğlu, 2019; Közikoğlu & Özcanlı, 2020). The related literature frequently stated that teachers especially care about values education (Dincer & Gözel, 2019; Gür et al., 2015), consider it necessary (Bayırlı et al., 2020; Sayın, 2020), and prioritize problem-solving skills (Calp & Edis, 2020). However, the primary teachers hardly ever mention the achievement of math and engineering skills as they may not know mathematics and engineering skills (Özkan & Akçay, 2021) and cannot express how to structure them (Saraç & Yıldırım, 2019). As a result, the participant teachers mentioned the 21st-century skills and values education themes more than the mathematics and engineering skills in the curriculum because of their having low curriculum literacy. It is thought that teachers are more familiar with the themes of 21st-century skills and values education through scientific studies in this field, measurement tools and instruments, activities and weeks highlighted by MoNE and related institutions. Especially with similar activities and studies emphasizing stem, mathematics and engineering skills will also increase the teachers' awareness in this field. As Akgündüz et al. (2015) stated, Turkey is at a lower level than the USA and EU countries in terms of mathematics and engineering skills and awareness, so universities and related institutions should conduct studies and related projects related to STEM education.

Primary teachers refer to the principles of vitality, concretizing, students-centered and active learning, using the constructivist approach, and focusing on enjoyable and game-centered learning environments with the help of technology in the learning-teaching process, in which the achievements of the curriculum are realized. In this respect, the teachers are consistent with the philosophy and general objectives of the curriculum during the implementation process of the curriculum. However, the teachers complained throughout the interviews that the curricula were not designed considering regional differences. However, MoNE (2018) expects teachers to make adjustments and adaptations in curricula in realizations and achievement of objectives and aims. This results from the fact that teachers cannot internalize the curricula sufficiently and have low curriculum literacy. Teachers with sufficient curriculum literacy can make the adjustments and adaptations in curricula in the implementation process, making them more functional by considering their feature of being designed as a framework (Yakar, 2016; Tan, 2005). The feature of the framework is required in areas where curricula are designed from a single center and used jointly throughout the country (Ornstein & Hunkins, 2014). Thanks to this feature, only the outlines of the program and its elements have been determined, and it provides the opportunity to adapt it to the conditions of the school and region during the implementation process (Akpinar, 2014). Therefore, teachers are expected to adapt curricula to their students and teaching environments by preparing annual plans that include the planning of education throughout the academic year (Öztürk, 2012). However, instead of making use of the curriculum, the teachers frequently complain that the curriculum does not consider regional differences as they access the annual plans prepared by teachers in other regions and provinces of the country via the internet (Aslan & Cökük, 2018; Coban, 2020; Günal & Akdağ, 2021). This is an indicator of teachers' inadequate curriculum literacy rather than a curriculum-related problem, as curriculum literacy requires consideration of geographic, economic, and cultural differences during the implementation process (Keskin, 2020; Karataş et al., 2022). As a result, teachers who cannot adapt the curriculum to their region, school, and student level will not reach a sufficient level of curriculum literacy. In this case, it will lead to the deterioration in the unity of the curriculum implementation and the emergence of a learning-teaching process that differs from its aims and implementation principles (Kahramanoğlu, 2019). In this study, some of the primary teachers stated they felt burnout during the teaching-learning process; they only focused on saving the day, while some of them stated that they only focused on the achievements of aims or included extra-curricular activities.

In the measurement and assessment process, primary teachers used both traditional and alternative measurement and evaluation tools together to determine students' achievement. Despite this, it is understood that the teachers do not record the data of assessment and evaluation tools, and they think it is sufficient for the evaluation process just to get to know the students. Primary school curricula emphasize the use of measurement and assessment tools and activities that supports, complete, and provide more information about the student by focusing on the development of students in the process (Karataş & Oral, 2019; Tuncer & Geçim, 2019). In this context, it recommends teachers benefit from observation forms, checklists, rubrics, and assessment scales (MoNE, 2018). However, in this study, some teachers stated that they must use the measurement as mentioned above and evaluation tools; they also preferred the use of traditional measurement and evaluation tools such as tests, openended questions in written or oral forms, true-false tests too. In addition, the participant's primary teachers used the test technique from the traditional assessment tools and the observation technique most among the alternative ones. The related literature also supports this result and teachers frequently were concluded to use the observation technique as one of the alternative assessment and evaluation tools (Duran, 2016; Özkoparan, 2016) because primary teachers do not feel qualified enough to use all of assessment and evaluation tools thus it is timeconsuming for them (Tuncer & Geçim, 2019). Therefore, primary teachers need counselling and information on the effective use of measurement and assessment tools (Carnevale, 2006). As a matter of fact, the main condition of a teacher to be able to apply a method or technique effectively is to know that subject. Otherwise, as in curriculum literacy, the application of something without knowledge will not be possible (Özenç & Çakır, 2015).

As a result, this study was carried out to examine primary teachers' curriculum literacy to provide deeper and more detailed information as an alternative to the quantitative study findings in the related field. However, since the study is based on the self-declaration of primary teachers, it is limited to their perceptions and views. In this respect, studies based on classroom observations, analysis of teachers' documents, or mixed methods are also needed. Anyway, the study contributes to the curriculum evaluation, literacy, and fidelity studies in the literature or to researchers working in these fields as it is thought to provide deep and detailed data on the curriculum literacy of primary teachers working with curricula of various disciplines. In addition, based on the results, we suggest that informative meetings and training should be provided to the primary teachers about the curricula they have implemented or will implement during the seminar periods of school, and scientific meetings should be organized where teachers can come together and discuss their practices on implementing curricula.

Author (s) Contribution Rate

Dr. Sedef SÜER: Literature review, statement of the problem, research questions, data collection and analysis discussion and implications.

Dr. Mehmet DEMİRKOL: Statement of the problem, research questions, data collection and analysis, discussion.

Conflicts of Interest

No potential conflict of interest was reported by the authors.

Ethical Approval

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Grounded Theory Approaches: A Comprehensive Examination of Systematic Design Data Coding

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Grounded Theory Approaches: A Comprehensive Examination of Systematic Design Data Coding

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Abstract

This study focuses on Grounded Theory, which is one of the qualitative research designs. Glaser and Strauss developed the Grounded Theory; it has been revised by other scientists, resulting in three distinct Grounded Theory approaches: the systematic design (Corbin and Strauss approach), the classical design (Glaser approach), and the constructivist approach (Charmaz approach). This research aims to discover the key characteristics of grounded theory through a comprehensive examination of these three methods and to show the systematic design in depth. In Grounded Theory research, the systematic design is favoured above other designs, so it is essential to understand the application steps carefully. As a result, the systematic design, which is similar to other designs in terms of fundamental characteristics, exhibits coding stage variances. In this regard, it is intended that the study will alleviate ambiguity in Grounded Theory research, particularly during the coding phase.

Keywords: Grounded Theory, Systematic design, Classic design, Constructivist approach, Data coding.

Introduction

Scientists have always been fascinated by people's perceptions, interpretations, and thoughts regarding their environment, social and cultural lives, situations, and occurrences. The paradigms of scientific study are classified in several ways. One of them is the positivist paradigm, critical paradigm, and hermeneutic paradigm classification. The first of these classifications is quantitative the others are approaches used in qualitative research.

In recent years, qualitative research has begun challenging the positivist paradigm's dominance, which seeks the ultimate truth. Attempts are being made to interpret, through a qualitative study, the facts and ideas disregarded by positivism. Instead of relying on existing theories and hypotheses, qualitative research methods attempt to explain social realities based on the individuals and interpersonal interactions that reveal these truths. Numerous research designs, including grounded theory, ethnography, phenomenology, case study, and action research, are utilized in qualitative research. The grounded theory of these research patterns is the focus of this study.

Glaser and Strauss developed grounded theory, although it was later amended by several scientists. As a result, in GT, three distinct designs emerged: Isystematic design (Corbin and Strauss approach), (ii) classical design (Glaser approach), and (iii) constructivist approach (Charmaz approach). Corbin and Strauss' systematic pattern; preset categories to associate categories with one other; it also employs assumptions to make visuals and connections evident. In contrast, the Glaserian classical pattern attempts to study social reality without preset classifications. Charmaz's constructivist method, on the other hand, falls somewhere in the midst between systematic and classical design. A constructivist approach challenges the notion of measured objective reality, arguing that meaning develops from interactions between persons rather than passively and ineffectively waiting to be discovered in objects. Although these patterns differ in practice, they all share the following characteristics: I process approach, (ii) theoretical sensitivity, (iii) theoretical sampling, (iv) continuous comparative analysis, (v) core category, (vi) theoretical note (memo) writing, and (vi) production (elik and Ekşi, 2015). These eight traits, along with the similarities of the three patterns, indicate the overall characteristics of GT and the concepts that should be understood about the theory. As a result, the concepts that are crucial in GT have been investigated by incorporating these features and are provided under the following title.

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Furthermore, distinct coding methods were discovered in the literature research among the three patterns in the data analysis. The classical pattern, for example, consists of the steps I open coding, (ii) theoretical coding, (iii) continuous comparative coding, and (iv) selective coding (McDonald, 2001). The constructivist method includes I initial coding, (ii) focused coding, and (iii) theoretical coding (Charmaz, 2006). The systematic pattern employs I open coding, (ii) axial coding, and (iii) selective coding (Corbin and Strauss, 1990).

However, due to the constraints of this research report, precise coding types for all of these patterns are not possible. According to Creswell (2012), Corbin and Strauss' systematic design comprises plainly recognized steps and is often utilized in GT research. As a result, it is critical to thoroughly read the application phases. In this regard, it is anticipated that the research will add to the body of knowledge. First, the definition and theoretical framework of Grounded Theory are discussed below, followed by the historical evolution. The basic elements of the grounded theory, as well as the basic concepts associated with the theory, are next analyzed. Finally, in accordance with the goal of this study, Systematic Grounded Theory and systematic design data coding were thoroughly studied.

Grounded Theory: Definition and Theoretical Framework

Grounded theory (GT), also known as theory formation, grounded theory, sub-theory, implicit theory, grounded theory, and structuring theory in the literature, is a theory that explains how to create a theory from systematically collected data (Kaya, 2015), particularly in psychology, education, and medicine. It is a commonly utilized research method (Mills, Bonner, & Francis, 2006).

The primary goal of research conducted from a positivist perspective is to verify or reject current theories. Qualitative research aims to establish new theories (Çelik & Ekşi, 2015). GT is a methodological technique that derives theory directly from knowledge, bridges theoretical and practical unknowns, and gives researchers a more liberating perspective (Goulding, 1998, cited in Çelik and Ekşi, 2015).

GT is the process of developing a theory using an inductive approach based on data collected while investigating a phenomenon (Corbin & Strauss, 2008). According to Goulding (2002), GT is a strategy that explains behaviors and the consequences of behaviors to extract and convey the theory that is grounded in the data intelligibly. Creswell (2012), on the other hand, defined GT as a qualitative research approach employed when a systematic theory or process relating to a genuine issue needs to be revealed systematically. Many researchers use GT to extract previously unknown theories grounded in data (Sonmez and Alacapnar, 2013); a method used when one wants to create a theory, change a theory, or develop a general abstraction about a process, people's actions, and interactions (Anderson, 2007); a method that allows solving the puzzle in the data collected from the research field by providing a set of systematic and flexible instructions and examples.

Quantitative research was not able to respond to any study in the field of sociology, and GT emerged as a result of the search of these researchers (Çelik and Ekşi, 2015). The theory is one of the research methodologies utilized when more specific facts, explanations, and a theory are required to examine any social issue. Rather than imposing the truth under study on an existing theory, GT is one of the systematic and comparative qualitative research approaches used to construct a theory that may explain reality most exactly and consistently feasible (Creswell, 2007). GT is both a method and a methodology, according to Balc (2015). It is a method since research can be conducted as a standalone application of GT. GT is a design because it can be used as a data collection approach with or without other data collection techniques.

GT seeks to derive theory from evidence acquired through interviews, observation, or document analysis, which distinguishes it from other methods of qualitative research (Glaser & Strauss, 2006). This is not the only element that distinguishes GT from other qualitative research approaches. Table 1 summarizes the discrepancies found in Charmaz (2006) and Creswell (2013) research.

Table 1. Grounded Theory Compared to Other Qualitative Research Methods

	Other Qualitative Research Methods	Grounded Theory
Data collection and analysis	on The process of collecting and analyzing data is made up of a series of steps that are connected and go in a straight line.	Data gathering and analysis (as well as theory development) are carried out concurrently.

Creation and coding of categories	Hypotheses that have been tried before or that were made at the start of the research are used to make categories, which are then used to code the data.	Data is used to creating categories. The coding procedure begins immediately after the first meeting) without waiting for the categories to form.	
Coding purpose	Coding is done to reach the themes.	Coding is used to get to the theory.	
literature review	The literature is examined before data collection, and a theoretical framework is created.	A preliminary review of the literature is carried out. However, the researcher disregards the concepts gleaned from the literature. The literature, however, is carefully examined once the data has been processed and the linkages between the data have been considered.	

Source: Based on research by Creswell (2013) and Charmaz (2006).

GT differs from other qualitative research designs in steps such as the activities performed during data collection and analysis, the creation of categories and the path followed during the coding process, the coding process's purpose, and the literature review's length, as shown in Table 1.

In addition to the differences listed in Table 1, GT focuses on theory development at each stage of data collection and analysis, enables comparisons by employing the "continuous comparison method" at each stage of analysis, and is used to determine the characteristics of the categories, their similarities and differences, from the initial meeting to the report writing. It is a qualitative research technique that permits drafting theoretical notes (memo) that outline the key paths of inquiry (Charmaz, 2006). According to Sonmez and Alacapnar (2013), both qualitative and quantitative research methods are utilized in the GT. According to the researchers, the qualitative research approach is utilized to acquire the data, and then the quantitative research method is implemented.

As with other forms of qualitative research, the theory employs an inductive methodology and attempts to make meaning of the data (Merriam, 2013). Attempts are made to interpret the examples in light of the acquired data and to derive a theory from the collected facts by considering perception, subjectivity, and sensitivity (Birgili, 2015). GT formed its own principles, according to Glaser and Strauss (2006), which is another commonality between the theory and other qualitative research methodologies. According to Row (2003) (quoted in Balc, 2015), the theory's guiding ideas are as follows:

- I. The investigation of social reality does not commence with a hypothesis. In other words, data is not treated from a well-established, widely accepted perspective.
- II. GT should be based on local accounts and experience in addition to the underlying facts.
- III. A method of continuous comparison should be utilized. To achieve this objective, the data should be categorized to build concepts and light the data, and these categories should be placed within a general analytic framework and populated with instances pertaining to the examined event. In addition, errors should be mentioned in the categories that are generated.
- IV. Data analysis should not rely on hypotheses or coding schemes that have been preconceived. The researcher should be open and transparent during the analysis process.
- V. In GT, the literature research is utilized in coding additional data and comparing agreed-upon codings. The developed theory will direct the researcher to the literature that best explains the results.

In qualitative research, interviews are typically recorded. In GT, however, this is viewed as a time-wasting activity, thus, the researcher captures the data in "field notes."

If the researcher discusses the idea before it is complete, it will lower his motivational energy, lead to criticism, and have the added benefit of delivering a reward. Therefore, it is suggested that the researcher remain silent.

Following the ideas as mentioned above, GT can be said to have two primary principles. Research is not initiated to prove, deny, or develop a new theory. Attempts are being made to formulate a previously undiscovered theory

based on the GT data. Thus, the potential that another theory or body of literature will influence the researcher has already been eliminated. According to the second principle, the continuous comparison method is vital for GT. Because the hypothesis was discovered using this way to determine the relationship between events and characteristics (Glaser & Strauss, 2006).

According to Charmaz (2006), the perspective of GT on social events is also a pillar in the construction of the research's intended theory.

From the perspective of GT, all social reality notions are interconnected and interdependent. In other words, no reality is uncaused; rather, it formed as a result of the influence of another reality. Therefore, the event under investigation should be accessible in practice and drawn from everyday life.

According to Glaser and Strauss (2006), a theory developed via GT is always applicable and permits the explanation of the investigated behavior and its causes. In addition, this theory, which was developed as a result of the research, gives verifiable hypotheses and serves as a guide for subsequent researchers studying the behaviors that are the subject of the theory. Considering these explanations, it can be stated that the researchers of GT and the researchers who started their research based on an existing theory and tried to confirm or refute this theory had different perspectives and were in opposition to each other as the theory was derived from the research.

Development of Grounded Theory

Barney G. Glaser and Anselm L. Strauss conceptualized grounded theory, one of the qualitative research designs. The methodological and theoretical basis of the theory as established in the 1965 publication "An Awareness of Dying," which resulted from a qualitative investigation of the experiences of inpatient and dying patients at the University of California-San Francisco Medical Center (Creswell, 2008). The method, referred to as the "continuous comparison method" in the book, has undergone numerous improvements and is now known as "grounded theory" (Balc1, 2015; Çelik & Ekşi, 2015). Glaser and Strauss, who laid the basis of the theory in their work "The Awareness of Death," initially and thoroughly articulated GT in their 1967 book "The Discovery of Grounded Theory" (Merriam, 2013).

Glaser and Strauss, the pioneers of the idea, are two researchers who grew up with completely different philosophies. Strauss is a qualitative researcher at the University of Chicago, whereas Glaser is a researcher at Columbia University, which has a long quantitative and theoretical study history. Despite their various perspectives, they integrated their study into the book "Discovery of GT," which is still the topic of several studies and describes GT (Creswell, 2007). Developed initially by two researchers, GT diverged in its early phases because of these researchers' divergent ideas, resulting in a dichotomy in practice. This paradox has a substantial bearing on the approach and methodology chosen for the research. In Strauss's approach, for instance, the researcher has a concept of where to begin his inquiry. In contrast, Glaser's method requires the researcher to begin with an empty mind. Moreover, according to Glaser, the theory is revealed by the facts in which it is concealed, whereas according to Strauss, data must be compelled for theory development (Jones & Alony, 2011). Some scholars accept Glaser's methodology, whereas others adopt Strauss' methodology, which correlates to the terms "Glaserian" and "Straussian" in the literature. Table 2 details the differences between the two approaches.

The Glaserian Approach	Straussian Approach		
It begins with general interest (with a blank mind).	It begins with an overview of where to begin.		
Developing theory through the use of objective questions.	Using structured questions, the hypothesis is tested.		
A conceptual theory is constructed.	There is a conceptual definition (description of situations).		
Theoretical sensitivity (the capacity to perceive variables and correlations) emerges with a concentration of data.	Approaches and tools facilitate the development of theoretical sensitivity.		
The theory's groundedness in the data contributes to its plausibility or support.	The precision of the procedure reveals the veracity of the theory.		

Table 2: Distinctions between the Glaserian and Straussian Methodologies

A fundamental social process must be specified.	The fundamental social process requires no definition.
The researcher is a passive participant.	The investigator is active.
Data reveals theory.	Data is structured to reveal theory.
Coding is not particularly stringent. Continuous comparison between occurrences, impartial inquiries, and categorization improve coding. Care is required to avoid over-conceptualization when defining the key points.	Coding is performed with greater rigor and precision. The type of comparison is determined by the coding technique. Microanalysis, which involves 'word-by- word'' data analysis, is used for coding.
There are two types of coding procedures: Simple coding . In this process, data is broken down into parts and then grouped conceptually. Substantive coding. It is performed to reveal the categories and priorities.	 There are three types of encoding procedures: Open coding. It includes the phases of defining, naming, classifying, and defining the phenomena. Axially coding. It is designed to assign codes to one another. Coding on a selective basis. It is performed in order to select a core category and correlate it with additional categories.

Source. Jones ve Alony, 2011.

GT, "Theoretical Sensitivity" by Glaser, published in 1978; "Qualitative Analysis for Social Scientists" by Corbin and Strauss, authored in 1987; and "Basics of Qualitative Research: Grounded," published in 1990. In the books, "Theory, Procedure, and Techniques" are elaborated and enhanced (Charmaz, 2006). Glaser claimed in his 1992 response to Corbin and Strauss's 1990 book, "The Foundations of Grounded Theory," that he rejected the perspectives of the researchers cited therein. The following are some of Glaser's criticisms of Corbin and Strauss (Charmaz, 2006):

- Systematic comparisons will afford the researcher considerable convenience in the process of theory construction. Therefore, researchers do not need to hear the tedious comparisons that Corbin and Strauss make.
- The desired hypothesis is concealed in the data. This notion can be revealed through coding and constant comparison.
- The GT researcher must operate freely and with flexibility. In contrast, Corbin and Strauss made the formation of the theory extremely rigid, irreversible, and difficult to comprehend.

These disagreements between Glaser and Corbin-Strauss have resulted in the development of distinct approaches to grounded theory. The following are examples of these approaches (Creswell, 2007):

- 1. The Corbin and Strauss method: a methodical design
- 2. The Glaser strategy: an evolving/classic design
- 3. Charmaz's method: a constructivist strategy

Obviously, there are three different designs in GT. The systematic design of Corbin and Strauss, predetermined categories to relate categories, and the use of hypotheses to clarify images and relationships. In contrast, the classical Glaserian design attempts to examine social reality without preset classifications. On the other hand, the constructivist method of Charmaz is situated between systematic design and classical design. It contends that meaning does not passively and ineffectually await discovery in objects but rather arises from interactions between persons. Although they differ in practice, they all share the following characteristics: I process approach; (ii) theoretical sensitivity; (iii) theoretical sampling; (iv) continuous comparative analysis; (v) core category; (vi) theoretical memo writing; and (v) they share some common features such as literature review and production. These eight traits, along with the similarities between the three designs, indicate the overall characteristics of GT and the theory's key concepts. Consequently, significant GT concepts have been examined by combining all of these factors.

Key Characteristics of Grounded Theory and Related Concepts

Under this heading, we examine the most essential aspects of grounded theory and the most essential concepts associated with it.

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Process Orientation

In GT study, a single social reality is emphasized. Nonetheless, this reality cannot be considered apart from individuals and their interactions. Since the investigated social reality will be modified by the actions and interactions of individuals, researchers concentrate more on process analysis (Creswell, 2012). For instance, a GT researcher who wishes to investigate the notion of mentoring may frame the topic of her study as "the advisor-student interaction between thesis supervisors and doctorate students."

The GT research process (Çelik & Ekşi, 2015), which is typically expressed using noun-verb pairs (substance addiction, discovering GT, leadership skill, the effect of preschool education, the level of initiative, etc.), entails the researcher abstracting and defining the participant statements' actions. These constructed abstractions and definitions are referred to as categories (concepts). Categories; They are necessary touchstones for producing a theory that is proven, intelligible, and comprehensive (Creswell, 2012).

Theoretiacal Sensitivity

The capacity to interpret categories derived from research data, to differentiate between similar and distinct categories, and to construct relationships between categories constitutes theoretical sensitivity. This ability directly influences the completeness and precision of the theory to be derived from the facts. Consequently, the capacity to analyze and comprehend data with theoretical sensitivity is a crucial component of GT (Corbin & Strauss, 2008).

Probabilistic Sampling

It is based on facts gathered through observation, interview, a document study, and everyday experiences (Corbin & Strauss, 2008). Therefore, the acquired data should be extracted from the most representative sample of individuals or groups to provide the correct hypothesis. Creswell (2012) underlined the significance of determining the type of sampling method to employ to pick the individuals to be included in the research (purposive sampling) and indicated that theoretical sampling, which permits simultaneous data collecting and analysis procedures, should be considered. Theoretical sampling, according to the researcher, is selecting people who can supply helpful texts, images, or case studies to aid in the theory-building process. Based on this definition of Creswell (2012), the following are examples of theoretical sampling: Students, parents, Montessori educators, and others will be surveyed by a researcher examining the impact of Montessori education on the development of preschoolers.

Constant Comparative Evaluation

In GT, data coding and analysis are concurrent and adaptable processes. During this phase, the researcher uses continual comparative analysis to uncover and develop concepts concealed within the data. This strategy seeks to connect a data-identified event to other events, events to categories, and categories to other categories (Creswell, 2007). Figure 1 depicts the continuous comparative analysis method that Jones and Alony (2011) depicts.



Figure 1. Constant Comprative. Source. Jones ve Alony, 2011.

The objective of the constant comparison method is to produce diversity by correcting the categories disclosed during the process with newly obtained samples (Birgili, 2015). In GT research, comparisons are done continuously within and between conceptualization levels until a theory is developed (Merriam, 2013). Using the continuous comparison approach, a GT researcher I compares occurrences inside each category, (ii) identifies the categories and category features, (iii) delimits the theory, and (iv) writes the theory (Goulding, 2002).

Primary (Core) Category

The core category is the category with the potential to be the researched phenomenon's central theme. When there are approximately ten categories (this number can be increased or decreased based on the size of the database), the researcher selects a core category to serve as the foundation of the theory he will build. It then determines the link and frequency of the core category with other categories. The researcher creates further categories if the relationships between categories make sense and fit (Creswell, 2012).

Taking Theoretical Notes (Memo)

Researchers at GT jot down brief notes regarding the data gathered from the beginning to the finish of the study. These notes are known as memos. Memos provide the most concise description of recent scientific developments. These annotations can be as short as a few lines or as long as tens of pages (Charmaz, 2006).

Memos give researchers summative data during the data-questioning phase (Goulding, 2002). A researcher who writes a memo elevates qualitative research to an empirical and analytical level, according to Charmaz (2006). According to Goulding (2002), a GT researcher who does not produce a memo develops a theory that is unrelated to GT.

Literature Review

All GT designs highlight the importance and necessity of a literature review. However, there are variations in designs dependent on location and function. In systematic design, for instance, the literature study is conducted first in order to create theoretical sensitivity prior to data collection and analysis. However, the researcher should not rely on the literature too heavily, as doing so will make it more difficult to generate fresh ideas. The Glaserian approach (classical design); He disagrees with Strauss and Corbin's suggestion to conduct a literature study prior to beginning the investigation. According to this theory, literature review confines researchers and makes category development difficult. Consequently, the literature review should follow data analysis. Charmaz (2006), the founder of constructivist GT design, stated that researchers should use the literature to (i) learn about previous GT

studies, (ii) explain who did what, when, and why, (iii) identify gaps between existing knowledge and situations, and (iv) formulate their own contribution to the GT field

Theory Development

GT's ultimate objective is the development of a medium-scale theory. The researcher's GT theory is an abstract explanation or comprehension of a real subject that is concealed in the facts (Creswell, 2012). GT theory is developed using three major tactics (Çelik & Ekşi, 2015):

- (i) Reducing the number of categories: During the initial stages of the research, a large number of distinct categories are identified and clustered based on their unique qualities.
- (ii) Selective sample of the literature: The literature evaluated in GT serves as a type of data source and is incorporated into the produced theory, classifications, and subcategories.
- (iii) Selective sampling of data: In GT, efforts are made to obtain additional data from the study region to develop and test hypotheses.

According to Corbin and Strauss (1990), the theory to be developed in GT research is a narrative or a brief summary of the investigation. The scholars as mentioned earlier suggested to GT researchers the following (Corbin and Strauss, 1990):

"...what occurred here?" Sit down and compose a few sentences about the subject." Express your ideas simply and compose a concluding narrative."

Based on the previous information, it can be concluded that the systematic and simultaneous collection and analysis of data is a prerequisite for the theory to be developed at the end of the study GT, regardless of the design (systematic, classical, constructivist). In the literature survey for this study, different coding strategies were discovered for the three data analysis designs. However, the limitations of this research report make it impossible to include detailed coding types for all of these patterns. The systematic design developed by Corbin and Strauss includes easily identifiable steps and is widely used in research GT (Creswell, 2012). For these reasons, only data coding according to the systematic design is examined in detail below.

Systematic Grounded Theory

This design, devised by Corbin and Strauss, is more rigid and canonical than the original GT design created by Glaser (Creswell, 2007). The systematic design is a GT design that emphasizes the development and visualization of theory through the use of preset coding phases (Corbin and Strauss, 1990).

The systematic design states that finding or accepting a known fact overlaps with positivist techniques, therefore, the goal of GT is not to affirm the known but rather to attempt to uncover the unknown. Strauss and Corbin defined data collecting and analysis procedures as a "open buffet" and argued that each researcher should select approaches according to his or her preferences (Creswell, 2007). Corbin and Strauss (Corbin and Strauss, 1990) enumerated the processes to be followed and the rules to be considered by researchers who utilize the systematic GT design:

- (i) The processes of data collection and analysis are interconnected. In GT, analysis commences with gathering initial data, and the resulting information is utilized in the subsequent interview or observation.
- (ii) The researcher does not utilize pre-existing conceptions, conceptualizes the data, and employs conceptual labels. An exact labeling is performed if a label is met with a particular frequency. One of the participants, for instance, used the statement "Women avoid taking chances and flee from danger. In addition, they are extremely emotional and cannot act professionally as a result." statement may be classified a "stereotype." "by the investigator. If other participants use this term in the same manner, the label "stereotype" is recorded.
- (iii) Similarities and differences are highlighted through the creation of categories. For instance, additional concepts such as "time pressure" and "role conflict" can be developed in addition to "performing numerous roles." While coding, the researcher recognizes that these notions are distinct but interrelated, therefore they can be categorized as "individual factors."
- (iv) Sampling is predicated on concepts and the diversity of concepts, not on groupings of individuals. For instance, if the researcher is conducting a study on the "organizational dimension of the glass ceiling," she should examine female managers in their workplaces. However, the researcher should not sample

female managers. Instead, she should investigate the organizational reasons that prevent women managers from advancing.

- (v) The event under study is often compared to other events in terms of similarity and dissimilarity. This is called the "method of continuous comparison." Continuous comparison is a method that keeps the researcher from bias, allows him to question each new piece of information and concept, and corrects coding errors.
- (vi) Obtained data should be evaluated for compatibility with a design and system because relevance promotes the advancement and integration of data.
- (vii) It is quite challenging for the researcher to keep up with the ever-changing categories, hypotheses, and queries. A mechanism is required to support the researcher in this process. This method is referred to as "theoretical memo writing." It begins with the first coding phase and continues till the conclusion of the research. Too many concepts are missed if the researcher skips annotation and moves directly from the coding process to report writing.
- (viii) In order to comprehend the links between categories, hypotheses are established. Throughout the research, these hypotheses are regularly amended until all the findings gathered from documents, observations, and interviews are confirmed.
- (ix) The researcher should compare the concepts and relationships he has discovered with those of other researchers and, if necessary, seek their assistance.
- (x) Higher (macro) conditions that affect the phenomenon should be included in the analysis, not just those intimately related to the phenomenon. The term for this is "situational matrix." For instance, economic position, culture, and political leanings should be incorporated into the investigation.

Systematic Grounded Theory Research Procedures

According to Creswell (2012), eight steps will assist systematic GT researchers in their approach

Step 1: *Selection of the most appropriate design.* This is the stage where decisions are made about the research design depending on the research topic's nature, scope, and sensitivity. For example, it is appropriate to use GT for topics where participant privacy must be protected (such as sexual abuse) because this design allows the researcher to conduct a macro-analysis rather than a micro-analysis and see the big picture.

Step 2: *Determine the process*. In research, the first step is to determine the process because the main purpose of GT is to explain the process. The people who interact and act reciprocally in the systematic GT design should also be included in the research process.

Step 3: *Confirmation and access*. As with any scientific research, research permission must be obtained and the sample to be collected must be accessible at GT.

Step 4: *Theoretical Sampling.* Data collection is one of the most important phases of a systematic GT. Therefore, this step - selecting the sample that can provide detailed and rich information and choosing the technique to collect data from the sample - refers to the process of obtaining new data by returning to the field until the theory develops and matures.

Step 5: *Coding the data.* This involves dividing the research data into categories and subcategories, identifying and explaining the relationships among the categories, and creating an overall picture of the research processes.

Step 6: Selective coding and theory development. In this process, the theory begins to develop. In this step, the researcher presents the theory as a series of theses or subtheses.

Step 7: *Verification of the theory*. This stage determines whether the researcher's theoretical explanations are logical and whether they describe events hierarchically.

Step 8: Writing the research report. GT Research report; It consists of four parts: (i) problem, (ii) method, (iii) discussion, and (iv) results. The researcher usually writes the report in the third person, paying attention to both structure and objective style. The report ends with a detailed explanation of the theory.

The Process Of Data Analysis and Theory Construction in Systematic Grounded Theory Research

Coding is performed in a systematic design to analyze and conceive the data and show the data's design. Using predetermined analysis steps, the theory is meant to be disclosed (Corbin & Strauss, 2008). Charmaz (2006) compared the codes to the bones constituting the research's skeleton. According to the researcher, it is through these codes that the connection between the data analysis and the theory drawn from the data is made. Systematic GTs coding procedure consists of three sequential phases. These procedures are categorized as I open coding, (ii) axial coding, and (iii) selective coding (Corbin and Strauss, 2008).
Open coding (Leve I/substantive coding). Open coding is the initial coding process in which the data are broken into sections in order to conceive and categorize them (Creswell, 2012). It is also known as "coding on the first pass through the data" (Neuman, 2008). At this level, data are separated into smaller units (Vatansever, Çalşkan, & Işık, 2014). Open coding labels similarities and differences between events, actions, and interactions that are compared to other events, actions, and interactions. Similarities permit the construction of subcategories deriving from the categories (Corbin & Strauss, 1990).

Systematic GT relies on "Who? What? Where? When? Why?" queries and comparisons as its code foundation. In order to determine the similarities and differences between categories, the researcher must ask productive and comparative questions. In addition, the data must be collected in the proper category for accurate and exhaustive analysis. Even if the researcher misclassifies the data, he has the option to rectify his error by employing the continuous comparison method. Open coding can utilize dissimilar coding types that do not have a linear relationship and can be used transformatively (Corbin & Strauss, 2008). These coding methods are detailed below: word-by-word coding, line-by-line coding, event-by-event coding, and in vivo coding.

Word-by-word coding Coding data obtained from the study of documents and electronic resources typically employs word-by-word coding, which allows for a methodical GT analysis of data in great detail (Charmaz, 2006). In this sort of word coding, attention must be paid to the meaning of words and the flow of sentences.

Line-by-line coding. Line-by-line coding is one of the most prevalent forms of coding in systematic GT, in which each line of participant statements is designated by name. Although this creates some coding challenges because occasionally, each line does not contain a complete sentence, it allows researchers to swiftly code the data. Researchers should follow the following adaptable procedures for line-by-line coding (Charmaz, 2006): I dissecting the data, (ii) identifying the activities on which the data are based, (iii) paying attention to implicit assumptions, (iv) discovering implicit actions and meanings, (v) focusing on the significance of emphasis, (vi) comparing the data with other data, and (vii) highlighting data gaps.

According to Charmaz (2006), line-by-line examination of coded data prevents researchers from being mired in existing one-word codes and opens the door to novel concepts and ideas. Charmaz (2006) noted that, during this procedure, how do I describe data on this topic? (ii) How does the procedure function? How do the participants conduct themselves? (iv) How do people communicate their ideas? Why and how does the procedure evolve? What are the results of the procedure? He stated that asking yourself questions facilitates a critical examination of the data (see APPENDIX 1 for an example of how this works).

Event Coding. Event coding is a sort of coding in which the researcher compares an event to one or more other events and, if a match is found, seeks to compare the new event to the event conceptualizations he or she has previously coded (Çelik & Ekşi, 2015). According to Charmaz (2006), event coding yields more significant results when researchers lack sufficient knowledge about participants, have trouble connecting with them, or can simply observe them. Moreover, studying people's behavior in public locations and coding it line by line can result in data loss if the observation is interrupted. Instead, occurrences should be researched independently, then compared, and events with similar characteristics should be coded together.

In- Vivo coding. In-vivo refers to the phrases that participants use. In vivo codes do not exist in the scientific literature or as notions invented by researchers. In other words, in vivo codes are the symbolic coding of the expressions of participants (Charmaz, 2006). For instance, one participant used "relativity" instead of "relativity theory" in the field of science and general physics, "theory according to Du-Mir" in the field of nuclear physics, "creditor" instead of "proton," and "electron" instead of "neutron." The participant's usage of the term "borrower" is an example of unique coding. These original codes should be stored as "in vivo codes" by the researcher. Since in vivo codes are conveyed by the participants, they give the researcher information about the participants' feelings, thoughts, and attitudes towards concepts, events, and circumstances. In addition, these codes were utilized to describe how individuals who expressed their opinions about a scientific concept in their own terms understood that concept.

Axial coding (Level II/theoretical coding). It is a second review of the collected research data (Neuman, 2008). Axial coding, defined as "creating a dense network of relations around the axis of a category," is a sort of coding that began to be employed with creating primary categories. In this coding phase, the material broken into small meaning units in the open coding phase is synthesized and attempts are made to create higher-level structures (Strauss and Corbin, 1998, as quoted in Vatansever, alşkan, and Işk, 2014). In axial coding, categories are paired with their subcategories, and these associations are evaluated based on data (Corbin & Strauss, 1990). Axial coding is typically favored for encoding huge quantities and varieties of data. This coding style aims to explain the codes established using open coding more precisely and reduce uncertainty (Charmaz, 2006; Glaser & Strauss,

2006). This coding process needs inductive and deductive reasoning, the formulation of questions and suggestions (McCann & Clark, 2003, quoted by Onat Kocabyk, 2016). According to Strauss and Corbin (1990), as reported by Charmaz (2006), a GT researcher conducting axial coding will perform the following tasks:

- A category is selected from the categories established during the open coding procedure, and coding is continued by focusing on this concept in the subsequent procedure. The term for this category is "core phenomenon."
- (ii) The gaps created by open coding between categories and subcategories are identified, and axial coding is utilized to diminish the discrepancies between categories and establish links.
- (iii) By evaluating and comparing data, connections between categories and subcategories are attempted to be built and expanded.

To make the relationships between the categories in axial coding clearer and more understandable, researchers must pay attention to the conditions affecting the social phenomenon they are studying, the routine and strategic reactions of the participants, and the outcomes of these actions and interactions. Conditions "why? where? how? when?" are their questions; actions and interactions "by whom? how?" are their questions; and the consequence "what is the effect of this action?" demands answering the query "what is the outcome of this action?" (Corbin & Strauss, 2008). According to Creswell (2012), axial coding should employ the conditional matrix approach, which involves building links between conditions, outcomes, and subsequent actions. According to the researcher, once the linkages have been formed, micro and macro factors influencing these relationships should be generated, and the data should be analyzed from a broader viewpoint. In addition, the core phenomena and the circumstances influencing the core phenomenon, the strategy derived from the core phenomenon, the specific and contextual circumstances influencing the strategy, and the outcomes should be given in detail. Figure 2 depicts the axis-coding procedure as depicted by Creswell (2012).



Figure 2. Axial Coding. Source. Creswell, 2012.

Selective coding (level III coding). Simply put, the selective coding procedure in systematic GT is the primary category selection mechanism (Corbin & Strauss, 2008). After a continuous comparative analysis (McCan & Clark, 2003, as quoted by Onat Kocabiyik, 2016), the "core category" (Corbin & Strauss, 1990) is selected to represent the central phenomenon of the study. All previously determined categories are organized around the "central category" and systematically related in selective coding (Creswell, 2012). (Corbin & Strauss, 2008). (Strauss and Corbin, 1990, as referenced by Creswell, 2012): I description of the event design, (ii) combination of the supplementary categories around the core category, (iii) linkage of the categories, (iv) data evaluation, and (v) saturation of the categories. In selective coding, the most significant processes are thought to be theoretical coding and note taking. Theoretical coding incorporates classification and saturation based on theory, so the data are interpreted as theoretical instead of descriptive. In this context, "classification" refers to organizing the data into meaningful categories, while "saturation" refers to determining the number of concepts in each category and subcategory (Eaves, 2001).

As can be seen, three distinct processes are involved in coding the systematic GT. It is important to note that at the core of all three types of coding are processes that involve thoroughly examining all the data, the creation of codes and categories, focusing on the relationships between categories, and the ultimate goal of uncovering the theory buried in the data. Nevertheless, the sub-digits of each coding type represent distinct operations. Figure 3 from Eaves (2001) illustrates these variances (quoted in Celik and Eksi, 2015).



Figure 3. Data coding and categorization steps in Strauss and Corbin approach. Source. Eaves, 2001.

In summary, researchers begin the process of coding with "open coding" and the creation of categories. In the next phase, axial coding, the categories are seen and combined. In the final step of coding, known as "selected coding," the core category is identified and a theory is constructed (Ilgar and Coşgun-Ilgar, 2013).

Reporting Grounded Theory Research

After coding, explaining, and categorizing the data gathered during the research GT, the research report is drafted. Coding, explanation, and classification help the research report writing process. As a means of condensing the theory and enhancing the readability of the concepts, the report may use a combination of tables and figures. By offering a literature review, the theory is situated in a scientific perspective. Review and presentation of the report in terms of style and language (Balc1, 2015).

Testing Validity in Grounded Theory Research

According to Yıldırım and Şimşek (2013), validity in qualitative research refers to the accuracy of the research findings and denotes that the researcher views the phenomenon objectively. Contrary to other studies, according to Elliott and Lazenbatt (2004), GT uses four criteria: appropriateness, relatedness, interoperability, and changeability (as cited in Kaya, 2015). The following is a brief explanation of these standards (Balc1, 2015):

- (i) *Fit*. The degree to which concepts and events they reflect are relevant.
- (ii) *Relevance*. The researcher focuses on the participants' genuine interests.
- (iii) *Workability*. The theory demonstrates how to address the problem.
- (iv) *Modifiability*. As new situations and data become accessible, the theory can be modified.

Conclusion

In recent years, qualitative research methodologies have become increasingly prevalent in scientific studies and more popular among researchers. In qualitative research that emphasizes the significance of interpersonal relationships and interactions in developing social facts, numerous distinct designs are employed. An example of one of these study designs is grounded theory.

In its broadest definition, grounded theory is the theory awaiting discovery in data that has been methodically collected, arranged, and evaluated. The theory was developed by Glaser and Strauss and then revised by many scientists. In addition to influencing other scholars, disagreements among the theory's founders led to the development of three distinct GT approaches: systematic design, classical design, and a constructivist approach.

In practice, Strauss and Corbin's systematic design, which uses predetermined categories to associate categories with one another, Glaser's classical design, which attempts to discover social reality without predetermined categories, and Charmaz's constructivist approach, which is situated between systematic design and classical design, differ in several ways. aspect; process approach, theoretical sensitivity, theoretical sampling, continuous comparative analysis, core category, memo writing, and theory production. In addition to pointing to the fundamental concepts, rules, and principles of GT and the application processes, these eight characteristics aid researchers in practice.

In this study, the systematic design (Corbin and Strauss approach), the classical design (Glaser approach), and the constructivist approach (Charmaz approach) from the Grounded Theory research techniques were analyzed in detail, and the parallel components in all three approaches were identified. The fundamental characteristics of GT were thus exposed. In addition, a literature analysis conducted within the scope of the study revealed that researchers in GT investigations frequently select the systematic design; thus, this design was explored in depth. Due to this, it has been determined that the systematic design is in a significantly different stage of coding than other designs.

Recommendations

Grounded theory is one of the qualitative research approaches; comparing designs that differ in the coding phase with a field study may aid in gaining a better grasp of the topic. In addition, it will be advantageous for other scholars to do field research to concretize the coding stages of the systematic design.

In the Grounded theory; there are three different approaches: systematic design (Corbin and Strauss approach), classical design (Glaser approach), and constructivist approach (Charmaz approach). There is a need in the literature for studies that show the similar and different characteristics of these approaches.

Conflicts of Interest

The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The corresponding author carried out the entire research process. The author have no conflict of interest to disclose.

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Annex-1. <i>Line by line coding example.</i>						
Line-by-line coding	Participant: OYe1, 37 years old, school administrator					
Problem	It will prevent women from rising in management					
Do not accept	I don't think there is a second glass ceiling. Even though they					
Charging responsibility	are other sources. So it is. After all, legally					
Supporting his thinking on	If he and I both want to rise to the highest position					
legal grounds						
Blame	We have the right. If women can't get high it's their own fault					
Blame	Because I can't see any obstacles other than themselves					
Prejudice	I, there are no barriers other than my own personality traits.					
Prejudice	They are very emotional for once. Then with a problem					
Prejudice	They panic when they meet. Other than that, he has other jobs.					
Gender attribution	Of course, they need to get their work done in the 10th house					
	first.					
Gender attribution	If he doesn't, there will be problems with his wife.					

ANNEXES





Figure. Axial coding of the collected data on expression designs. Source. Charmaz, 2006, s.62.



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An Analysis of the Relationship between Primary School Fourth-Grade Students' Writing Performance, and Student and Class Variables

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An Analysis of the Relationship between Primary School Fourth-Grade Students' Writing Performance, and Student and Class Variables^{*}

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Abstract

This study aims to examine the writing performance of primary school fourth-grade students in relation to the student-level variables (writing, reading comprehension, self-regulation-based writing, writing motivation, and writing anxiety) and classroom-level (teacher) variables (knowledge of text-writing instruction and text-writing instruction self-efficacy beliefs). The data were collected from Zonguldak, Turkey in 2019-2020 academic year. The study used a correlation research method consisting of 734 fourth-grade students at primary school and 31 classroom teachers. The data collection tools included the Story Text and Informative Text Assessment Analytical Rubric, Writing Achievement Test, Reading Comprehension Test, Self-Regulation-Based Writing Scale, Writing Motivation Scale, Writing Anxiety Scale, and Text-Writing Instruction Form for Classroom Teachers, and Text-Writing Instruction Self-Efficacy Beliefs Scale. A two-level Hierarchical Linear Modelling (HLM) analysis was performed on the data. The results showed that students' writing knowledge, reading comprehension level, and self-regulation-based writing skills play a significant role in their writing performance. The student-level variables examined in this study account for the text-writing performance of students by 24%. The study presents the results based on the findings and recommendations based on the results.

Keywords: Writing skill, Primary school fourth-grade students, Classroom teachers, Hierarchical linear modeling

Introduction

Since writing is a tool for learning and communication that is acquired and developed during school years, it is essential to provide early opportunities for its improvement so that it can be utilized effectively throughout one's life. As writing requires many cognitive, affective, and psychomotor skills (Graham, 2006; Zimmerman & Risemberg, 1997), it is, however, quite a complex and difficult task (Graham & Harris, 2009; Graham et al., 2018; Graham et al., 2019). Therefore, a formal education is needed to acquire and develop writing skills.

The beginning of education life is the first and most important stage, where writing and written expression skills can be acquired. Still, it is not enough to gain writing skills alone to effectively use written expression skills. Writing and written expression skills are likely to be affected not only by student-related factors but also by teachers, who constitute an important part of the process. In this regard, this study has aimed to examine the impact of factors originating from students and teachers on text-writing skills.

Theoretical Framework

Factors Affecting the Writing Skill

'Knowledge' has played a central role in almost every major writing model proposed for the last half century (Saddler & Graham, 2007). The studies on writing knowledge (Benton et al., 1995; Fitzgerald & Markham, 1987; Gillespie et al., 2013; Graham et al., 1993; Graham et al., 2005; Graham, 2006; Graham et al., 2007; Lin et al., 2007; McQuitty, 2011; Olinghouse & Graham, 2009; Saddler & Graham, 2007; Zumbrunn, 2010; Zumbrunn & Bruning, 2013), seem to deal with it in the context of instructions about how to write, as well as linguistic

^{*} This study was derived from the first author's doctoral thesis.

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knowledge, relevant information about writing topics, text types, and their structures, and metacognitive knowledge about writing processes.

Individuals with advanced writing skills appear to have a high level of knowledge about the basic elements required to produce quality texts and their characteristics (Harris et al., 2010). Research has shown that more skilled writers prove more well-informed about writing than their peers are (Graham et al., 1993), students' writing knowledge improves within the developmental process (Graham, 2006; Saddler & Graham, 2007), and it significantly affects the writing performance (Olinghouse & Graham, 2009) and can be improved with practices such as writing instructions based on self-regulation (Harris et al., 2006).

Writing successful texts is closely related to certain variables in a learning environment, such as some skills of the writer/child and the qualifications of teachers in addition to the knowledge of basic writing and language skills (MacArthur & Philippakos, 2013). Despite showing different characteristics in terms of their uses and consequences, reading and writing skills have a common basis, such as written language and cognitive skills, both of which have a constructive effect on building meaning, indicating that these two skills are very deeply interconnected (Alves et al., 2020; Graham, 2020; Tompkins, 2018). In this regard, it is possible to claim that a child's writing success is related to his/her reading comprehension skill.

A writer's ability to organize the writing process and his/her self-regulation skills are other personal variables with an impact on writing success. It is, therefore, often recommended to teach metacognitive skills (Kaya & Ateş, 2016) and self-regulation strategies to improve writing skills (Boekaerts & Corno, 2005; Hammann, 2005; Zimmerman, 2008; Zimmerman & Risemberg, 1997). Researchers (Graham & Harris, 2000; Harris et al., 2010; Zimmerman & Martinez-Pons, 1986; Zimmerman & Risemberg, 1997) state that the strategies used by successful writers in the writing process include focusing attention, organizing the environment, mental design, cognitive strategies, goal setting and planning, organizing/transforming, searching for information, seeking outreach, self-monitoring, and self-assessment. In the process of self-regulation-based text-writing, skilled writers benefit from strategies for managing complex processes of planning, drafting, evaluation, and proofreading (MacArthur & Philippakos, 2013; MacArthur et al., 2015; Nami et al., 2012), and perform specific writing tasks (Harris et al., 2002).

MacArthur et al. (2015) stated that besides self-regulation, writing requires a high level of motivation. Bruning and Horn (2000) noted that as students improve their writing skills and learn about the writing process, they are closer to experiencing writing achievement, which may be effective in increasing students' writing motivation. Motivation, which is very important in the development of writing, especially in starting and completing it, and comprises of many components such as self-efficacy beliefs, interest, attitude, goal-orientation, success, and failure (Troia et al., 2013), denotes an individual's internal drive or progress towards a goal (McLeod, 1987).

Another factor affecting the writing skill is 'anxiety'. Writing anxiety is the state of anxiety or fear towards writing when faced with a writing task (Fisher, 2017). Students who have difficulty putting their thoughts on paper consider the act of writing a feared and disturbing task (Daly, 1985). All writers have a certain amount of anxiety, which is indeed necessary, yet for some, it can be devastating (Daly & Miller, 1975). According to McLeod (1987), this feeling can be turned into a positive effect.

The necessity of students to develop the ability to express themselves in writing has increased the emphasis on teaching how to write (Berrier, 2009). Since writing is a difficult and complex skill (Graham & Harris, 2009; Graham et al., 2012; Graham et al., 2019; Lunenburg & Lunenburg, 2014), teachers should devote their time to writing activities every day in order to instruct their students on how to use writing processes for different purposes, as well as teaching how to spell, write regular sentences and fluently, and to motivate their students to develop their writing skills (Graham et al., 2012). Another factor affecting the writing skill can be indicated as 'teachers.'

Teachers play an active role in training students, providing support, giving feedback, and modeling writing practices (Hodges, 2015). They can help students to become effective writers by teaching various strategies for each component of the writing process, such as planning, drafting, reviewing, and editing, and by supporting students until they can apply these strategies independently (Tracy et al., 2009; Zumbrunn, 2010). Still, this teaching and support alone is not enough. Teachers should be aware of their perceptions of writing and know how this affects their instruction (Thornton, 2010). At this point, it is possible to argue that teachers' knowledge and beliefs about writing will definitely influence students' writing skills, based on the 'Peter Effect' by Applegate and Applegate (2004).

Teachers' beliefs are directly related to their practices and have an impact on students' educational lives (Gaitas & Martins, 2015). Therefore, it is necessary to determine teachers' beliefs about their ability to teach their students to write texts effectively (Bañales et al., 2020). However, teachers' true beliefs about writing instruction have been largely ignored by researchers (Graham et al., 2002). Further research is, therefore, needed to examine whether teachers' writing practices are directly linked to students' writing performance (Bañales et al., 2020).

In the literature, a restricted number of studies (Brunstein & Glaser, 2011; Deniz, 2017; Kim, 2019; Kim & Schatschneider, 2017; Limpo & Alves, 2013) that examine the multiple factors affecting writing skill and modeling the relationship between these factors generally focus on the relationships among the cognitive dimensions of writing, the language skills besides cognitive skills (Kim, 2019), and psychomotor skills (Yıldız & Yekeler, 2017). In only one study (Limpo & Alves, 2013), a component related to motivation (self-efficacy), which is from among affective dimensions, was also included in addition to the cognitive dimension. Another study (Baştuğ, 2015) examined only the relationship between attitude, tendency, and writer's block, which are among the affective dimensions of writing. Although its importance is frequently emphasized in writing studies, students' emotional orientation towards writing has received little attention from researchers (Piazza & Siebert, 2008). Most of the studies on modeling writing skills were conducted with students above the primary school level.

It is essential that students get a good start on writing, a skill they will use throughout their lives. In the literature, the writing skill is generally examined in small groups on a single level, mostly at the student level, and studies on the teacher factor are limited. This study aims to make more realistic predictions about writing performance by considering student and teacher factors together. Therefore, a framework was created to observe the effects of different factors on students' writing skills and to better understand the relationship between students' writing achievement and student and classroom (teacher) characteristics. Figure 1 presents the levels and variables included in this framework.



Figure 1. Levels and variables examined in the research

This study aimed to investigate the relationship between the text-writing skills of the primary school fourth-grade students and the *student-level* (level 1) and *classroom(teacher)-level* (level 2) variables. To this end, answers were sought to the following questions:

- 1. What are students' text-writing skills, writing knowledge, reading comprehension, self-regulation-based writing, writing motivation, writing anxiety, and teachers' knowledge of text-writing instruction and text-writing instruction self-efficacy beliefs?
- 2. Are the variables of students' writing knowledge, reading comprehension, self-regulation-based writing, writing motivation, and writing anxiety significant predictors of students' level of text-writing skills?
- 3. Are the variables of teachers' knowledge of text-writing instruction and text-writing instruction self-efficacy beliefs significant predictors of students' level of text-writing skills?

The fact that there is no other study in the literature in which student and teacher characteristics affect students' writing performance with a modeling study has been an important factor in conducting this study. For this reason, the study focused on revealing the relationship between dependent and independent variables whose effects on writing performance were examined within the framework of a hierarchical linear model and on offering suggestions for improving writing performance at the primary school level.

This study is expected to provide significant contributions to the study field in eliminating the gaps mentioned above in the literature and is considered important in terms of revealing to what extent the writing performance is related to student and class level characteristics through the Hierarchical Linear Modelling (HLM) analysis conducted on the text-writing skills of primary school fourth-grade students.

Method

Research Design

This study used the correlational research method to examine the relationship between student and classroomlevel variables and students' text-writing performance. The main purpose of correlational research is to clarify our understanding of important phenomena by identifying relationships between variables (Fraenkel et al., 2011).

Participants

The data has a two-level hierarchical structure as students and teachers. A multi-stage sampling method was adopted within the scope of a two-level linear modeling approach. First, the maximum diversity sampling method was used to determine the schools. Much attention was paid to the number of fourth-grades in schools and the existence of students from different socio-economic levels (SEL) while determining the schools to collect data. In the second stage, the criterion sampling method was used to determine the classes in the selected schools, and the size of the classes was considered. Data were collected from 31 classroom teachers working in 10 primary schools in Zonguldak, Turkey, and a total of 734 fourth-grade students studying in those teachers' classes.

Measurement Tools

Assessment of Text-Writing Skill

The participants were made to write stories and informative texts to determine their performance in writing skills. The texts were then assessed with rubrics developed by the researchers.

Writing Knowledge Test

The test developed by the researchers to determine students' writing knowledge includes 28 questions and consists of questions regarding the Knowledge of Writing Genres (Text Types and Characteristics), Knowledge of Writing Processes (Encountering Difficulties in Writing), Knowledge of Writing Strategies (Characteristics of Good and Weak Writers), and General Grammar Knowledge (Punctuation, Spelling, etc.). The KR-20 internal consistency coefficient of the Writing Knowledge Test is 0.86.

Reading Comprehension Test

The researchers developed a text-based 'Reading Comprehension Test' for story and informative text types to measure the students' reading comprehension capacity. Both texts were arranged according to the Maze Technique, which is one of the Cloze Test methods. Every eighth word was omitted in the texts starting from the second sentence onwards. There were 25 blanks in each test. The KR-20 internal consistency coefficient for the informative text type is 0.84; the KR-20 internal consistency coefficient for the story text type is 0.91.

Self-Regulation-Based Writing Scale

The researchers developed the 'Self-Regulation-Based Writing Scale' to determine the extent to which students use self-regulation-based writing strategies. The five-point Likert-type scale consisted of 21 items. The Cr α value of the scale consisting of a single factor was .89.

Writing Motivation Scale

The 'Writing Motivation Scale', developed by Öztürk (2013), was used in the study with the permission of the researcher to determine the writing motivation of fourth-grade students. The five-point Likert-type scale consisted of 22 items. The Cr α of the five-factor scale was .81.

Writing Anxiety Scale

The 'Writing Anxiety Scale', developed by Katrancı and Temel (2018), was used with the permission of the researchers to determine the writing anxiety levels of fourth-grade students. The three-point Likert-type scale consisted of 20 items. The Cr α of the four-factor scale was .91.

Text-Writing Instruction Form

'The Text-Writing Instruction Form' prepared by the researchers was used to determine the extent of knowledge of text-writing instruction of classroom teachers. There are 15 questions in the form consisting of the attributes such as the time devoted to writing studies, teaching writing processes, text types and content information, writing assessment/feedback, and writing strategies/exercises for students with weak writing skills.

Text-Writing Instruction Self-Efficacy Beliefs Scale

'The Text-Writing Instruction Self-Efficacy Beliefs Scale' developed by the researchers was used to determine the self-efficacy beliefs of classroom teachers for teaching how to write texts. Based on Bandura's (2006) classification, there are 28 items in the scale consisting of levels ranging from 0 (I cannot do it at all) to 100 (I can do it very well). The Cra value of the scale consisting of a single factor was .97.

Procedure

The data were collected from Zonguldak, Turkey, in the 2019-2020 academic year. Measurement tools were administered to the participants every other week, and the data collection process lasted six weeks. During the data collection process, the conditions that could affect the results' reliability such as the participants' interaction with each other and getting help from different sources, were prevented. Much attention was paid to administering the measurement tools during different course hours and at the beginning of each course hour.

Data Analysis

It is deemed more appropriate to use multi-level models in the statistical analysis of data with a hierarchical or clustered structure (Moerbeek et al., 2003). HLM analysis was conducted to determine the effect of student and teacher variables on the text-writing performance of fourth-grade students. The HLM clearly describes the multi-level data structures of clustered data. Regression coefficients could, thus, be calculated impartially (Raudenbush & Bryk, 2002).

The texts written by students and the form used to measure the classroom teachers' ability for text-writing instruction were scored by three different raters. Inter-rater reliability was examined to determine the consistency between raters. The Krippendorff alpha (α) coefficient was used to determine inter-rater reliability. In the evaluation of this coefficient, $\alpha < 0.67$ was considered a weak fit, 0.67 $\alpha < 0.80$ moderate fit, and $\alpha=0.80$ high fit (Krippendorff, 1995).

The Krippendorff α coefficient calculated for the three raters of the texts written by the students is 0.95, indicating that there is a high agreement among the raters. The Krippendorff α coefficient calculated for the Text-Writing Instruction Form is 0.90, showing that the scores given by the three raters are consistent.

Results and Discussion

The first research question of the study aimed to analyse the descriptive statistics on the levels of students' Textwriting skill (TWS), Reading comprehension (RC), Self-regulation-based writing (SRBW), Writing knowledge (WK), Writing anxiety (WA), and Writing motivation (WM). Table 1 presents the results of the descriptive statistics.

	TWS	RC	SRBW	WK	WA	WM
Ν	734	734	734	734	734	734
Mean	28,23	34,14	87,63	17,88	32,27	85,29
Standard Deviation	6,30	8,58	10,73	5,37	6,46	11,99
Skewness	-0,20	-0,63	-1,00	-0,25	0,33	-0,90
Kurtosis	-0,40	-0,26	2,22	-0,58	-0,20	1,66
Minimum	8	9	21	4	20	25
Maximum	44	49	105	28	54	110
Range	36	40	84	24	34	85

|--|

Table 1 shows that the mean score of students in *TWS* is 28.23. Although the skewness value of the score distribution is negative, it is very close to zero. Consequently, it can be inferred that students' text-writing skill is generally at a moderate level. The mean score of RC is 34.14, indicating that students' reading comprehension is generally at a high level. The mean of SRBW is 87.63, and the value of skewness (-1.00) indicates that students' writing skills based on self-regulation are at a high level. The mean score of WK tests is 17.88. The skewness value (-0.25) is negative, yet not far from zero, implying that although there are students with high writing knowledge, students' writing knowledge is generally at a moderate level. The mean score in the *WM* is 85.29, showing that students' writing motivation is generally high. The mean score in the *WA* is 32.27. A positive skewness value (0.33) indicates that writing anxiety is generally low.

Table 2 presents the results of descriptive statistics related to the level of Teachers' Knowledge of Text-Writing Instruction (KTWI) and Text-Writing Instruction Self-Efficacy Beliefs (TWISEB).

	KTWI	TWISEB
N	31	31
Mean	44,52	89,38
Standard Deviation	6,59	8,17
Skewness	0,25	-0,62
Kurtosis	-0,56	-0,59
Minimum	33	70,71
Maximum	59	99,11
Range	26	28,39

Table 2. Descriptive statistics on teachers' characteristics

As seen in Table 2, the mean score of teachers for their KTWI is 44.52. The value for skewness (0.25), although positive, is close to zero, indicating that teachers' knowledge of writing instruction is generally at a moderate level. The mean score in TWISEB is 89.38. The skewness value (-0.62) shows that teachers' self-efficacy beliefs in text-writing instruction are generally at a high level.

The two-level HLM analysis method was used to determine student and teacher characteristics that significantly predicted students' text-writing skills. Three different HLMs (one-way ANOVA with random effects, random coefficient regression model, and regression with means-as-outcomes) were tested to answer the research questions.

One-way ANOVA with random effects was used to examine whether there was a difference in text-writing skills among the 31 classes involved in the study. Table 3 presents the results regarding the fixed effects in this model, and Table 4 presents those regarding the random effects.

Table 3.	Fixed	effects o	f the one	-wav A	ANOVA	with	random	effects
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Fixed Effect	Coefficient	Standard Error	t	р
General Mean Score in the Writing Skill, γ_{00}	28.07	0.57	49.38	0.00

As seen in Table 3, the general mean score of students in text-writing skills was estimated at 28.07, the standard error of which is 0.57. The following confidence interval formula was used to determine among which values the students' general mean score in writing skills was at a 95% confidence interval.

 $\hat{\gamma}_{00} \pm (1,96)$.SH = 28,07 ± (1,96). (0,57) = (26,95,29,19)

According to this formula, the actual value of the general mean score of students in writing skills is between 26.95 and 29.19 with 95% probability.

Table 4. Random effects of the one-way ANOVA with random effects

Random Effect	Standard Deviation	Variance
Classroom-level, u_{0j}	2.94	8.65
Student-level, r_{ij}	5.59	31.28

As seen in Table 4, the intraclass variance (σ^2) is 31.28, and the interclass variance (τ_{00}) is 8.65. The intraclass correlation coefficient (ICC) was calculated to determine the contribution of class and student-level variables to the variance in students' text-writing skills. The variance between classes was divided by the total variance to calculate the intraclass correlation coefficient. The intraclass correlation coefficient revealed that classroom-level variables accounted for 22% of the variance in the text-writing skill of students, while student-level variables accounted for 78%.

Variance ratio for classroom-level: $\rho_{sinif} = \tau_{00} / (\tau_{00} + \sigma^2)$

= 8.65/(8.65+31.28) = 0.22

A random coefficient regression model was created to answer the second research question and determine the student-level variables that significantly predicted students' text-writing skill. The model included only the student-level predictive variables such as *RC*, *SRBW*, *WK*, *WA*, and *WM*.

Table 5 shows the fixed effects in the random coefficient regression model created to determine student characteristics that predict students' text-writing skills.

Fixed Effect	Coefficient	Standard Error	t	р
General mean of writing skill, γ_{00}	28.07	0.57	49.22	< 0.001
Reading comprehension, γ_{10}	0.16	0.03	4.74	< 0.001
Self-regulation-based writing, γ_{20}	0.06	0.02	2.5	0.013*
Writing knowledge, γ_{30}	0.23	0.05	4.21	< 0.001
Writing anxiety, γ_{40}	-0.04	0.03	-1.19	0.24
Writing motivation, γ_{50}	0.03	0.02	1.53	0.13

 Table 5. Fixed effects of the random coefficient regression model

As seen in Table 5, student characteristics that significantly predict students' text-writing skills include reading comprehension skills, self-regulation-based writing skills, and writing knowledge.

Reading comprehension ($\gamma_{10} = 0.16$, p<0.001) has a positive and significant relationship with text-writing skills, indicating that students with high reading comprehension skills are also more likely to have high text-writing skills. A positive relationship was observed between self-regulation-based writing ($\gamma_{20} = 0.06$, p = 0.013) and text-writing skills, signifying that students with high self-regulated writing skills have higher text-writing skills. Similarly, there is a positive correlation between writing knowledge ($\gamma_{30} = 0.23$, p<0.001) and text-writing skills.

Table 6 presents the random effects in the random coefficient regression model, which were examined to determine how much the student-level (Level 1) variables explained the variance in text-writing skill.

Table 6. Random effects of the random coefficient regression model

Random Effects	Standard Deviation	Variance	•
Classroom-level, u_{0j}	3.005	9.03	
Student-level, r_{ij}	4.888	23.89	

The study compared the variances obtained in the random effect one-way ANOVA, which is the empty model, and those in the random coefficient regression model containing only student-level predictive variables to determine the variance explained by the student-level variables in the study. As seen in Table 6, the student-level variance in the random coefficient regression model is equal to 23.89. In the one-way ANOVA with random effects, the student-level variance is 31.28 (see Table 4). According to this:

Level-1 explained variance ratio is equal to $=\frac{31.28-23.89}{31.28}=0.24$. The student-level variables explain 24% of the intraclass variance in students' text-writing skills.

Regression with means-as-outcomes was created to answer the third research question and determine teacher characteristics that significantly predicted students' text-writing skills. This model included only classroom-level predictive variables, such as teachers' *KTWI* and *TWISEB*.

Table 7 presents the results regarding the fixed effects in the regression with the means-as-outcomes model, which was created to determine the teacher characteristics that predicted students' text-writing skills.

Table 7. Fixed effects of regression with means-as-outcomes model							
Fixed Effect	Coefficient	Standard Error	t	Р			
General mean of writing skill, γ_{00}	26.215	6.878	3.811	< 0.001			
KTWI, γ_{01}	0.044	0.098	0.450	0.656			
TWISEB, γ_{02}	-0.001	0.077	-0.016	0.988			

Table 7. Fixed effects of regression with means-as-outcomes model

As seen in Table 7, teachers' knowledge of text-writing instruction is not a classroom-level variable that significantly predicts students' ability to write texts ($y_{01} = 0.044$, p = 0.656). Similarly, teachers' relevant self-

efficacy beliefs do not significantly predict students' ability to write texts ($\gamma_{01} = -0.001$, p = 0.988). Consequently, no significant relationship was observed between teachers' knowledge of text-writing instruction, their self-efficacy beliefs, and students' text-writing skills.

Table 8 presents the random effects showing the variance components in the regression with means-as-outcomes.

Table 8. Random effects of regression with means-as-outcomes model					
Random Effect	Standard Deviation	Variance			
Classroom-level, u_{0j}	3.05	9.29			
Student-level, r_{ij}	5.59	31.28			

Since the teachers' knowledge of text-writing instruction and text-writing instruction self-efficacy beliefs did not significantly predict students' ability to write texts, no comment was made on the explained variance.

Conclusion

In the first research question, the data analysis revealed that students are at quite a good level in reading comprehension. The reading comprehension test prepared according to the maze technique developed by Ulusoy (2008) indicated that the students are at the level of independent reading comprehension.

Students stated that they made use of self-regulation skills in the writing process with a high level of motivation for writing. Takımcıgil-Özcan (2014) reported that students' levels were above the mean score according to the writing motivation scale.

Students' achievement in text-writing and writing knowledge is generally at a moderate level. Although students appear at a high level in terms of self-regulation and motivation, they are at a moderate level in terms of writing knowledge. Saddler and Graham (2007) stated that the level of knowledge of talented writers is higher than that of less talented ones, and individual differences in knowledge are reflected in writing performance.

The students' writing anxiety was generally found low in the study. It can, therefore, be assumed that the students do not have a level of anxiety to negatively affect their writing or cause them to avoid writing, which seems to overlap with the findings about writing motivation. Some research in the literature also reported that the writing anxiety level of students is low (Karakoç-Öztürk, 2012; Tekşan, 2012).

One of the variables examined at the classroom level is teachers' knowledge of text-writing instruction. The scores for this variable were generally found at a moderate level. The responses of the teachers about the knowledge of text-writing instruction led to moderate scores from the following dimensions: 'time devoted for writing activities', 'text types and content knowledge', 'writing assessment/feedback', and 'writing strategies/activities for students with poor writing skills.' Nevertheless, they got slightly higher scores than the mean scores from the dimension of 'writing instruction processes.' It is obvious that although classroom teachers are partially knowledgeable about writing processes, this knowledge level is insufficient for students to perform process-based writing activities and produce qualified texts. It can, therefore, be noted that teachers' knowledge of writing activities, enhance their knowledge of text types and content, evaluate the texts effectively (for content rather than formal features) and give more feedback, acquire more information on the use of writing strategies and on the kind of activities to benefit from for students with poor writing skills.

Various studies conducted on writing instruction reported that most teachers spend very little time writing or on writing instruction (Gilbert & Graham, 2010; Kiuhara et al., 2009; Veiga-Simão et al., 2016) or rarely encourage students to use self-regulation skills in the writing process (Kiuhara et al., 2009; Veiga-Simão et al., 2016) and that a great many teachers do little or no work for students who have difficulty writing (Graham et al., 2008) or hardly ever include important types such persuasive, informative, and descriptive writing (Gilbert & Graham, 2010). The literature also shows that teachers' knowledge of writing instruction differs from the kind of activities they use in the classroom.

The classroom teachers' text-writing instruction self-efficacy beliefs were generally found to be high. In the literature, while some studies (Berrier, 2009; Mohtar et al., 2017) reported similar results on this variable, others (Graham et al., 2001) indicated that teachers' self-efficacy beliefs in writing instruction are at a moderate level. As a result, though the classroom teachers' knowledge of text-writing instruction is moderate, they appear to believe that they teach it well. Despite this, it is impossible to assert that this situation is reflected on the classroom environment adequately when both the teachers' knowledge levels and the students' writing performance are considered.

The second research question, the data revealed that the students' characteristics significantly predicting their textwriting skills include writing knowledge, reading comprehension, and self-regulation-based writing skills, and that there is a positive relationship between these factors and text-writing skills. Hence, it can be concluded that students will write more successful texts if their writing knowledge, reading comprehension, and self-regulationbased writing skills improve. In this sense, it is likely that students' writing knowledge level has a predictive effect on writing achievement. The literature has shown that there is a positive relationship between writing knowledge and writing achievement (Gillespie et al., 2013; Graham et al., 2019; Kim, 2019; Lin et al., 2007; Olinghouse & Graham, 2009; Saddler & Graham, 2007).

Another result indicates a positive correlation between *reading comprehension level* and *writing achievement*. Reading comprehensionskill appears to have an important role in developing writing achievement. As the reading comprehension level of the students increases, they will be more likely to write successful texts. Some studies in the relevant literature support a similar result (Deniz, 2017; Jouhar & Rupley, 2020; Koons, 2008; Yıldız et al., 2020). In this regard, students' reading comprehension levels should be improved so that they will be able to write more qualified texts.

The present study identified a positive relationship between *self-regulation-based writing skills* and *writing achievement*. It can, thus, be considered that self-regulation-based writing skills have an important role in the development of writing achievement. It is also expected that as students' level of using self-regulation-based skills in the writing process increases, so will their success in text writing. There are studies in the literature supporting the result that as students' self-regulation skills develop, their writing skills will develop accordingly (Englert et al., 1988; Graham & Harris, 2000; Harris et al., 2006; Limpo & Alves, 2013; Yıldız & Yekeler, 2017; Zimmerman & Bandura, 1994).

No significant relationship was found between students' *writing motivation, writing anxiety, and* writing skills. Motivation and anxiety levels alone do not seem sufficient to influence writing achievement, and such factors need to be supported with the development of writing knowledge, reading comprehension, and self-regulation skills. However, some studies in the literature report a positive relationship between writing motivation and writing achievement (Graham et al., 2017; Graham et al., 2019; Troia et al., 2013). As a common aspect in those studies, the following detail draws attention: Students with writing difficulties and inadequate writing skills were included as participants in those studies, and no evaluation was made to identify students with such characteristics. In this study, however, the students with learning, writing, or reading difficulties were identified and excluded.

The difference between *writing motivation* and *writing achievement* can be explained by the fact that the students in the study group differ from those in other studies in terms of learning, writing, or reading difficulties. Relevant studies have generally focused on a specific text type (story and persuasive text) (Graham et al., 2017; Graham et al., 2019; Takımcıgil-Özcan, 2014; Troia et al., 2013), worked with students at different grades (Graham et al., 2019; Troia et al., 2013), and been conducted in different countries (Graham et al., 2017; Graham et al., 2019; Troia et al., 2013), so the participants in this study and others have been raised in different cultures and educated according to different education programs, all accounting for the difference in results.

No positive relationship was observed between *writing anxiety* and *writing achievement*. Various studies in the literature support this result (Choi, 2013; Pajares & Margaret, 1994; Temel, 2018). The absence of a relationship between text-writing skill and writing anxiety may be due to students' relatively low level of general writing anxiety. When anxiety is very low or too low, it can negatively affect performance on a task being worked on.

The student-level variables examined in the second research question explained students' text-writing skills by 24%, which is remarkable in that the study reveals approximately a quarter of the student-level variables that explain the text-writing skill. According to this result, it can be asserted that studies should be conducted to determine other variables that affect the text-writing skill.

The third and last research question examined whether teachers' knowledge of text-writing instruction and textwriting instruction self-efficacy beliefs are significant predictors on students' text-writing skills. However, these variables were not found to significantly predict students' writing skills.

The present study is the first known study to statistically examine the impact of teachers' knowledge of textwriting instruction on students' text-writing achievement. In the literature, Bañales et al. (2020), having slightly similar aims to particular purpose of this study, reported that writing education does not make a unique, positive, or statistically significant contribution to the prediction of students' writing practices. They also pointed out that additional research is needed to examine whether the practices said to be done by teachers are related to students' writing performance. This is due to the fact that despite employing writing practices, a teacher may use them ineffectively and incorrectly.For this reason, the extent of effectiveness of the studies may vary depending on the writing activities of the teachers. Similarly, as long as teachers do not use their knowledge of text-writing instruction effectively in the teaching process, such education should not be expected to contribute to the textwriting skills of the students. This study is one of the restricted numbers of studies examining the effect of teachers' text-writing instruction self-efficacy beliefs on students' text-writing achievement. A study similar to this research conducted by Berrier (2009) with fourth-grade teachers reported quite a low relationship be tween teachers' text-writing instruction self-efficacy beliefs and students' writing performance. The results showed that teachers' text-writing instruction self-efficacy beliefs do not directly influence students' writing achievement. In like manner, this study determined that despite being high, teachers' self-efficacy beliefs did not significantly affect students' writing performance. On the other hand, Brindle et al. (2016) found that despite stating that they included various writing practices in their classrooms, the teachers were found to rarely apply them. For this reason, teachers' high level of text-writing instruction self-efficacy beliefs should not be interpreted as that they will act in line with this belief in the classroom environment and that their reflection on students' writing achievement will be high.

It is clearly evident that additional research is required to investigate the connections between the text-writing instruction self-efficacy beliefs of classroom teachers and the writing instruction methods that they implement for their students, as well as the success of the students' writing. Although it was determined that teachers' knowledge of text-writing instruction and their self-efficacy beliefs did not significantly mediate the development of students' text-writing skills, the results of this study showed that 22% of the variance in students' text-writing skill was explained by classroom-level variables and 78% by student-level variables. This finding shows that teachers are also influential in developing writing skills. Despite the existence of a teacher effect of 22%, it appears that the development of writing skills is mostly (78%) due to the student-level variables. Accordingly, it can be assumed that teacher effect alone is not enough to improve the writing skill, which student-level variables should rather support.

Recommendations

Suggestions for educators and practice

- This study proved that students' writing knowledge has a significant impact on their writing performance. Because of this, it is very important to have writing activities in the classroom to help students learn how to write better texts.
- It is of great importance for individuals to encounter and read works of literature that contain qualified and different types of genres from an early age. For this reason, starting from primary school, it should be ensured that students encounter qualified texts through both textbooks and children's literature products, and further studies should be carried out to improve their comprehension and writing skills.
- Creating educational environments that will encourage and develop students' self-regulation skills is necessary.
- The present study determined that the text-writing instruction self-efficacy beliefs of classroom teachers were high, yet their knowledge of text-writing instruction was at moderate level. Various trainings may be conducted to improve teachers' knowledge of text-writing.

Suggestions for researchers

- The student-level variables examined in the study explained the text-writing performance by 24%. Further studies are recommended to determine other student-level variables that affect students' writing performance.
- The variance rate (22%) observed at the classroom level did not arise from the teacher variables examined within the scope of the study. There are quite a restricted number of studies in the literature that examine the effects of variables in the teacher dimension on students' text-writing skills. It is recommended that further research be conducted to eliminate this gap. In addition, more studies may be conducted to determine which qualifications of classroom teachers influence students' writing skills.
- The results of the study indicated that teachers' self-efficacy beliefs were high in text-writing instruction but did not reflect much on students' success in writing texts. This led to the comment that the qualifications teachers believed they had and the work they performed in the classroom did not match well. According to this, further studies may be conducted to observe to what extent the teacher-level variable is valid in the classroom.
- This study concluded that writing motivation and writing anxiety do not have a significant impact on writing achievement. In the literature, there is a restricted number of studies -based on no experimental evidence- to examine the effects of such variables on writing skills. It is recommended that further studies be conducted to examine the effects of these variables on writing performance.

• This study has formed a two-level HLM as a student-level and classroom-level. Modelling studies could be conducted in which different levels such as school, district, province, and *variables* such as family, home, school type, class size, and gender are included.

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Author (s) Contribution Rate

The authors contributed equally at all stages of the research.

Conflicts of Interest

The authors reported no potential conflict of interest.

Ethical Approval

Since the data of this study, which was derived from the first author's doctoral thesis, were collected before 2020, the study does not require ethics committee approval. However, legal permission was obtained from the Ministry of National Education of Turkey. In addition, in this study, all the rules specified within the scope of the Higher Education Institutions Scientific Research and Publication Ethics Directive were complied with.

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Comparison of Problem-Posing Skills of Gifted and Non-Gifted Primary School Students

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Comparison of Problem-Posing Skills of Gifted and Non-Gifted Primary School Students

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Abstract

The purpose of this study was to compare the problem posing skills of gifted and non-gifted primary school students. In this study, the case study method was used. The participants who were selected by convenient sampling consisted of 24 gifted and 24 non-gifted students attending from the East of Black Sea region of Turkey. The data in the study were collected with an open-ended problem posing test that was developed by the researchers. This test consists of three situations requiring free, semi-structured and structured, problem posing. The data were evaluated according to the problem posing test evaluation form that was developed by the researchers. At the end of the study, while there was no statistical significance between gifted and non-gifted primary school students in free and semi-structured problem posing, it was found that non-gifted primary school students were statistically significantly better than gifted primary school students in structured problem posing.

Keywords: Gifted and non-gifted, Primary school students, Problem-posing

Introduction

Education of gifted students is one of the issues that is emphasized in developed countries. Because the proper and correct training of these students brings important contributions to both their countries and humanity, however, the desired level has not been reached in the field of education for gifted students in our country (Çitil, 2018). Students who are better than their age group in art, creativity, and academic fields (Worrell et al., 2019), have advanced metacognitive thinking skills, and need special education are called gifted students (Kurnaz, 2013). Gifted students pay attention to the fact that the learning environments are interesting and fun and organized in a motivating way (Yetim-Karaca & Türk, 2020). Otherwise, they exhibit behaviors such as reluctantly attending or not attending classes (Çetin & Doğan, 2018). For this reason, before starting the education of gifted students, differentiated education programs should be implemented by considering their readiness levels, learning speeds, interests, and learning styles (Heacox, 2002; Tomlinson & Alan, 2000). In this way, it is seen that gifted students' interest in mathematics increases and their mathematics learning skills improve (Inan, 2019).

Gifted students who can demonstrate mathematical skills at the level of older students are called gifted students in the field of mathematics (Sowell, Zeigler, Bergwell, & Cartwright, 1990). Students who are gifted in the field of mathematics have a high desire to study, a high level of creativity, and high motivation towards the mathematics lesson (Mingus & Grassl, 1999). In studies comparing gifted students with their peers; it is seen that gifted students have low mathematics anxiety, and their mathematics motivation, attitudes, self-efficacy, mathematics learning behaviors, and problem-solving performances are high (Bulut, Yıldız, & Baltacı, 2020; Gürel & Yetkin-Özdemir, 2019; Pajares, 1996; Wang, Huang & Hwang, 2016). Even gifted students, thanks to their ability to use induction, deduction, and analytical thinking skills, are seen to make fewer mistakes when solving non-routine problems and use different strategies to solve problems (Holton & Gaffney, 1994; Tertemiz, Doğan & Karakaş, 2017; Vaivre-Douret, 2011; Yıldız, Baltacı, Kurak & Güven, 2012). In this context, gifted students have more academic knowledge, memory, reasoning, and learning skills compared to non-gifted students, their creativity is developed; and their motivation is strong, i.e., their cognitive, emotional, and physical development is good (Koçak & İçmenoğlu, 2012; Maria, 2014; Maker & Nielson, 1996; Roznowski, Hong & Reith, 2000; Yıldırım, 2016) can be shown as a result of their being better in mathematics than non-gifted students.

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Gifted students are more successful in studies that require complex and difficult cognitive performance (Stuart & Beste, 2011); they see problem-posing as more difficult than solving (Manuel & Freiman, 2017). Problem-posing, which is a feature of special talent and creativity (Silver, 1994), is a skill that helps students to make sense of symbolic examples in a mathematical sentence, to develop a mathematical language suitable for this meaning, and to develop their ability to establish relationships between solutions (Rudnitsky et al., 1995). There are three different types of problem posing that contribute to the development of students' mathematical thinking skills. The first of these is structured problem posing. In posing a structured problem, students are asked to add additional information to the problem, change the conditions and data in the problem, adapt them to different themes, or pose a problem by reversing what is given with the solution. In free problem posing, which is the second type of problem posing, which is the third type of problem posing; the student is given a table, picture, situation, result, story, or is asked to pose a problem similar to the given problem (Kılıç, 2011; Yılmaz, 2019). There are different skills that problem posing brings to students.

Problem posing, which distracts students from the feeling of being the ones who solve only the questions asked by the textbooks or their teachers, enables students to actively participate in the process and take responsibility in the process (Nardone & Lee, 2011; Rizvi, 2004; Upu, 2003). Problem posing, which is a skill that requires more reflection than problem solving, increases students' interest and motivation, develops their reasoning and thinking skills, increases their learning success, and develops skills such as self-control and cooperation (Cai, Hwang, Jiang, & Silber; 2015; Christidamayani & Kristanto, 2020; English, 1997; Silver, 1994; Singer, Ellerton, & Cai, 2013; Toheri, Winarso, & Abdul Haqq, 2020). For this reason, it is one of the issues that teachers focus on.

In the primary school mathematics curriculum, it is seen that it concentrates on low-level cognitive steps such as application, understanding, and remembering, which include low-level cognitive steps, and the gains that include high-level cognitive steps such as analysis, creation, and evaluation are few (Aktan, 2020). In addition, it is seen that there are few mathematics lesson hours in primary schools, there is a shortage of materials, and students develop negative attitudes towards mathematics, but primary school teachers organize fun activities to overcome these problems and increase students' mathematics achievement (Yurtbakan, Aydoğdu-İskenderoğlu, & Sesli, 2016). In addition, it is also interested in problem posing in order to develop students' high-level thinking skills, such as creative and critical thinking and problem solving (Daher & Anabousy, 2018). Teachers, who take on the responsibility of supporting and increasing the academic development of students (Plunkett & Kronborg, 2011), need to provide students with problem-posing skills, especially in order for younger students to better internalize the concepts of mathematics (Chapman, 2006). For this, teachers can choose books that are prone to posing problems in their classrooms and ask students to pose problems based on a sentence or a picture in the book and then evaluate each other's problems (Yurtbakan & Aydoğdu-İskenderoğlu, 2020). By creating discussion environments in the classroom, they can support students in posing problems and encourage students to talk about their problem-solving processes (Gavin & Casa, 2012). While having students pose a problem, they can direct the problem to reflect their real-life situations (Abu-Elwan, 2002), and have computer-assisted problem posing exercises (Atalay & Güveli, 2017).

There seems to be a limited number of studies examining the problem posing skills of gifted secondary school students (Erdoğan & Gül, 2020; Manuel & Freiman, 2017) in the literature. It is seen that there are many studies examining the problem posing skills of non-gifted primary and secondary school students (Alzahrani, 2021; Bevan & Capraro, 2021; Bulut & Serin, 2020; Can & Yıldız, 2021; Dae-Hyun & Jinhee, 2010; Dölek & Caliskan, 2018; Kwon & Capraro, 2021; Özçakır-Sümen, 2021; Peng, Cao & Yu, 2021; Tertemiz, 2017; Yurtbakan & Aydoğdu-İskenderoğlu, 2020). The fact that there is only one study comparing the problem-posing skills of gifted and non-gifted secondary school students (Espinoza, Lupiáñez & Segovia, 2016) and that the study did not compare the problem-posing skills of gifted and non-talented primary school students makes the study necessary. In addition, the fact that gifted students with advanced thinking skills will be compared with their peers in problem posing skills that require creativity is also important in terms of revealing the creativity characteristics of gifted students. In this important study, the problem-posing skills of primary school 4th grade students with and without special abilities will be compared. For this purpose, answers to the following questions were sought in the study: 1- How do the problem-posing skills of gifted and non-gifted 4th grade students differ?

2- Is there a significant difference in the problem-posing skills of gifted and non-gifted 4th grade students?

Method

Research Design

In this study, the case study method was used in order to compare the mathematical problem-posing skills of gifted and non-gifted primary school students. This method persuades researchers to use different data collection tools together and study in depth in a short time (Çepni, 2010). In the study, the problem-posing and problem-solving abilities of gifted and non-gifted students were determined with an open-ended test and then analyzed according to the rubric.

Study Group

To compare the problem-posing skills of gifted and non-gifted students (24 gifted, 24 non-gifted), 48 primary school 4th grade students continuing their education in a public primary school, who were selected by convenient case sampling from purposive sampling methods, were included. Convenient case sampling is related to the fact that it is easier or more accessible for individuals or groups to be researched int the research process (Ekiz, 2009). In this study, the convenience sampling method was used in order to reach the 4th grade primary school students with or without special talents and to speed up the study. 14 of the gifted students were continuing their education at the Science and Art Center, and four of them were boys and ten of them were girls. 14 of the non-gifted students who are continuing their education in a primary school in Trabzon are four girls and ten boys. While these students were coded as G1, G2, ..., G24 for gifted students, non-gifted students were coded as NG1, NG2, ..., NG24.

Data Collection Tools

In order to compare the problem posing skills of gifted and non-gifted students, first of all, studies comparing the problem-posing skills of primary school students in the literature were examined (Tertemiz, 2017; Yurtbakan & Aydoğdu-İskenderoğlu, 2020). Then, an open-ended problem posing test consisting of 3 questions (1 structured, 1 semi-structured, and 1 free) was developed by the researchers. Opinions of two academicians and one primary school teacher in the field of primary school mathematics teaching were taken about the language and the suitability of the prepared questions for the level of primary school students. In line with expert opinions, necessary corrections were made in terms of language and expression in the questions. After expert opinions, the open-ended problem-posing test was administered to 15 primary school 4th grade students as a pilot study. As a result of the pilot study, the statements that were not clear to the students in the questions were rearranged, and the questions were finalized. In addition, with the pilot study, it was determined how long it would take for the students to complete the test. The following questions are included in the open-ended problem-posing test:

Free Problem Posing

Construct a difficult problem that requires using one or more of the natural numbers addition, subtraction, multiplication, or division operations and solve the problem which you pose.

Semi-Structured Problem Posing

"1 pen, 13 TL, 2 books, 55.50 TL" Pose a problem using the data on the side and solve the problem which you pose.

Structured Problem Posing

"Çınar has got 52 books. Zeynep's books are 14 less than Çınar's books. Mert's books are 7 more than $\frac{1}{4}$ of Çınar's books. How many books does Mert have?" Pose a problem for this situation and solve the problem which you pose.

Data Collection and Analysis

The open-ended problem-posing test was applied to gifted and non-gifted students at the end of the 2021-2022 academic year (2nd week of June). An open-ended problem-posing test was applied to gifted students on the day when they came to the Science and Art Center. It was applied to non-gifted students in the mathematics lesson at school. Students were given 40 minutes for three problem-posing questions in the open-ended problem-posing test. In addition, students were asked to solve their problems. The reason the students are asked to solve the problem they have posed is to make sure that they correct the missing part of the problem they have posed while solving the question.

In this study, qualitative data were analyzed with descriptive analysis, and quantitative data were analyzed with the Mann Whitney U test. While evaluating the problems posed by the students, the problem posing rubric was used by the researchers. Before the rubric was prepared, the rubrics in the literature prepared according to the

situations requiring free, semi-structured, or structured problem-posing for both gifted and non-gifted students studying in primary and secondary schools were reviewed (Erdoğan & Gül, 2020; Manuel & Freiman, 2017; Özçakır-Sümen, 2021; Yurtbakan & Aydoğdu-İskenderoğlu, 2022). Besides the rubrics, student answers were reviewed, and the form was finalized by creating different codes. Form was created by using the codes in the literature that examined the problem posing skills of primary school students before (Yurtbakan & Aydoğdu-İskenderoğlu 2022). Formally; it consists of 3 sections; characteristics of the problems posed (empty, unsolvable [there is a problem situation but no solution], incomplete [there is a problem but the data is missing or the data in the problem is missing but there is no question root], solvable [the problem can be solved with existing data]), the solution to the posed problem (empty), the correct solution, the wrong solution (missing operation, logical error, unused data, unit error, operation error)) and the status of having the characteristics of the problems described (1 step, 2 step, 3 step and more, adding new data, using all given, changing the given).

After the descriptive analysis, the answers given by the students were scored for the quantitative analysis. Scoring was done as follows: 1 point if it is a problem that contains a mathematical expression that can be understood and solved; 0 points if it is not a problem (problem expression is not understood, does not contain a problem statement) (see Table 1., Table 2. and Table 3.) Then, the statistically significant difference between the problems posed by the gifted and non-gifted students was examined with the Mann-Whitney U test.

Consistency among researchers in the open-ended problem posing test, which was analyzed separately by both researchers, was calculated using the Miles and Huberman (2004) formula. The 5% of the researchers, who did not show consistency among themselves, reached a common conclusion by discussing them. The sum of the scores obtained by the gifted and non-gifted students from the rubric was taken, and the differentiation status was examined with the Mann Whitney U test.

Results

Descriptive Features of the Problems Posed by Gifted and Non-Gifted Students

In this part of the study, descriptive features of free, semi-structured, and structured problems posed by gifted and non-gifted students are included. Table 1 shows the characteristics of the problems posed by both gifted and non-gifted students.

Prob-	Features	* *	Students				
lems			Gifted	Non-gifted			
	Empty		G8	-			
	Unsolvabl	le	-	NG3, NG20			
	Incomplet	te	-	-			
ing		1 step	G9, G11, G14	NG7, NG17			
sod m		2 step	G1, G6, G7, G12, G13, G17, G18, G21, G22	NG13, NG16, NG18, NG21, NG23			
ble		3 step	G2, G4, G23, G24	NG5, NG8, NG15			
[Free prol	Solvable	more than 3 step	G3, G5, G10, G15, G16, G19	NG1, NG4, NG6, NG9, NG10, NG11, NG12, NG14, NG19, NG22, NG24			
tuation (Solvable	Numbers not appropriate for level	G2, G7, G10, G23	NG2			
1. Si		Solution by drawing a figure	G20	NG19, NG20			

Table	1.	Characteristics	of	posed	probl	ems
raore	1.	Cha acteristics	O1	posed	probl	UIIIO

ed	5 Empty			G18	-
Unsolvable				-	NG2, NG3
nuc	incomplete			G5, G8, G9	NG5, NG7, NG9, NG10, NG11,
Situ i-st					NG20
2.5 Inti	c C Solvabla	Adding	new	G6, G7, G17, G21	NG1, NG4, NG6, NG8, NG12,
(se		data			NG13, NG14, NG15, NG16, NG17,

				NG18, NG20, NG22, NG23, NG24		
		Using all	G1, G2, G3, G4, G10, G12,	-		
		given	G13, G23, G24			
		Not using all	G5, G8, G9, G11, G14, G15,	NG19, NG21		
		of the given	G16, G19, G20, G22			
		Changing the	-	-		
		given				
	Empty		G7, G13, G14, G15, G18	-		
	Unsolvabl	e	-	NG2		
SOG	Incomplet	te	-	-		
d u		Adding new	G17	NG11,NG22		
olei		data				
rol		Using all	G1, G2, G3, G4, G5, G6, G8,	NG3, NG4, NG5, NG6, NG7, NG8,		
dp		given	G10, G11, G21, G24	NG9, NG10, NG12, NG13, NG14,		
ure		C		NG15, NG16, NG17, NG18, NG19,		
nct	0 - 11-1 -			NG21, NG24		
str	Solvable	Not using all	G9, G23	-		
ŭ		of the given				
ltio		Changing the	G12, G16, G19, G20, G22	NG1, NG20, NG23		
tua		given				
Si		Context	-	NG20		
ώ.		switching				

In the first situation, which requires free problem posing, gifted students mostly set up 2-step solvable problems, while non-gifted students posed solvable problems that required more than 3 steps (See Table 1). In the second case, which requires semi-structured problem posing, it is seen that gifted students can pose problems either by using all of the given data or by not using all of the given data; it has been seen that non-gifted students set up problems by adding new data. In the third case, which requires structured problem-posing, it has been determined that both gifted and non-gifted students can pose problems by using all of the given information. Table 2 shows how students solved their problems.

Solving		1. Situation	l	2. Situation	l	3. Situation	
		Gifted	Non-	Gifted	Non-	Gifted	Non-
			gifted		gifted		gifted
Empty		1	2	1	8	5	1
The right solving		22	16	13	7	16	18
	Missing	-	2			-	2
	transaction						
The wrong solving	logic error	1	1	1	2	-	2
	unused data	-	1	-	-	-	-
	unit error	-	1	-	-	-	-
	Operation error	-	1	9	5	3	1
	Getting the	-	-	-	2	-	-
	number wrong						

Table 2. Solving the posed problem

When the solutions to the problems posed by the gifted and non-gifted students are examined, in the first case, which requires free problem posing, and in the second situation, which requires semi-structured problem posing, it is seen that most of the gifted students can solve the problem posed better than the non-gifted students (see Table 2). In the 3rd case, which requires structured problem posing, it is seen that the number of non-gifted students who can solve the problem, albeit a little, is higher than the number of gifted students. In this sense, it can be thought that gifted students are more successful in solving free and semi-structured problems.

Table 3. Solving the posed problem

Prob	Features	Examples
- lems		



Solvable	Cinar'in 52 tang kitab var. 20100000 Cinar'in kitaplarindan 14 azdir. Mert'in kitaplan Cinar'in kitaplarinin ti inden 7 fazla. Toplan kitap sayasi kactir Cinar'i 52 42 52143+7=20 052 Cinichir
	Çınar has 52 books. Zeynep's number of books is 14 less than Çınar's books. Mert's books are more than $\frac{1}{4}$ of Çınar's books. How many books do the children have altogether? (NG9)

2- Statistically Significant Difference of the Problems Posed by Gifted and Non-Gifted Students

In this part of the study, the results of the quantitative analysis regarding the statistical significance of the problems posed by gifted and non-gifted students are given (see Table 4).

Table 4. Problem posing

Students	1. Situation			2. Situation			3. Situation			Total		
	Ν	Х	Sd	Ν	Х	Sd	Ν	Х	Sd	Ν	Х	Sd
Gifted	24	,917	,28	24	,583	,50	24	,708	,46	24	2,21	,88
Non-gifted	24	,917	,28	24	,667	,48	24	,958	,20	24	2,54	,72

In Table 4, it is seen that the arithmetic mean and standard deviation scores of the gifted and non-gifted students in free problem posing (Situation 1) are equal; in semi-structured and structured problem posing (2nd and 3rd cases), non-gifted students have higher arithmetic averages and lower standard deviation scores than gifted students. The Mann Whitney U-Test results performed to see if these values are significant are given in Table 5.

Situations	Students	Ν	Mean	of	Sum of	U	Z	р
			Ranks		Ranks			
1 situation	G	24	24,50		588,00	200 00	,00	1,00
1. Situation	NG	24	24,50		588,00	- 288,00		
2 situation	G	24	23,50		612,00	264.00	-,590	,56
2. Situation	NG	24	25,50		564,00	- 204,00		
2 situation	G	24	21,50		516,00	216.00	-2,299	,02
5. situation	NG	24	27,50		660,00	- 210,00		
Total	G	24	21,92		526,00	226,00	1 420	15
Total	NG	24	27,08		650,00	-	-1,430	,15

Table 5. Problem posing skills of gifted and non-gifted students Mann Whitney U test results

While there is no statistically significant difference between gifted and non-gifted students' free problem posing (1st case), semi-structured problem posing (2nd case), and total problem posing scores (p>.05), it is seen that there is a statistical significance in favor of non-gifted students in structured problem posing scores (p<.05) (see Table 5).

Conclusion and Discussion

At the end of the study conducted to compare the problem-posing skills of gifted and non-gifted primary school students, it was revealed that gifted students mostly pose problems that can be solved in 2 steps, while non-gifted students pose problems that require more than 3 steps. In semi-structured problem-posing, it has been determined that gifted students either use all of the given data or do not use all of the given data, while non-gifted students pose problems by adding new data. Gifted students continue their education in the same class in science and art centers after completing their educational activities in different schools. All of the students who are not gifted continue their normal education activities in the same class in their own schools. The fact that the classroom teachers of non-gifted students were conscious of problem-posing and had them do problem-posing exercises in mathematics lessons may have supported the development of problem-posing skills in the students. On the other hand, gifted students from different schools may not allocate enough time to problem-posing studies by their classroom teachers in the schools where they receive education. For this reason, it may be that both gifted and non-gifted students experience differences in free and semi-structured problem-posing. In structured problem-

posing, it has been observed that both gifted and non-gifted students can pose problems by using all of the given information. The reason why gifted and non-gifted students do not experience any difference in structured problem-posing may be that in structured problems, students adapt to the situation in the study by changing the numbers or changing the objects in the problem. In the literature, the problems posed by gifted students include more than one step (Manuel & Freiman, 2017); number types and quantities vary; question expressions differ semantically; at least four steps are required to solve problems, problems involve two or more computational processes (Espinoza et al., 2013); they can pose problems for four operations as well as practice writing; not being able to answer, logic. It is also seen that they experience problems such as making mistakes (Erdoğan & Erben, 2018). It is also seen that there are studies examining the characteristics of the problems posed by non-gifted students. In these studies, it is seen that students who are not gifted have difficulties in posing problems; there are deficiencies in the expressions of the problems they pose, they do not use the language well in the problems they pose; and therefore the problems are not understood to solve them, and the understood ones do not match the procedure used in the solution (Arıkan & Ünal 2013; Can & Yıldız, 2021; Carkci, 2016 Kartal, 2017). Contrary to these results, there are also results showing that non-gifted students are successful in posing problems; the problems they pose are logical and solvable, but the problems that the students pose are similar to the problems they pose in the classroom with their teachers (Dölek & Çalışkan, 2018; Kwon & Capraro, 2021; Özçakır-Sümen, 2021). When the situations of gifted students and non-gifted students posing arithmetic problems are compared, it is seen that the problems posed by mathematically gifted students are, require different steps, contain different computational processes to solve, and contain higher numbers with different semantic relationships. determined (Espinoza et al., 2016). In this context, the reason why both gifted and non-gifted students experience similarities and differences in problem posing may be due to their teachers' efforts to pose problems in mathematics lessons at schools. Because it is seen that enriched lesson activities in school to improve students' problem posing skills give positive results (Atalay & Güveli, 2017; Yurtbakan & Aydoğdu-İskenderoğlu, 2020; Kim & Hodges, 2012).

In the study, it was revealed that gifted students were more successful than non-gifted students in solving free and semi-structured problems. This may be due to the fact that gifted students use more strategies when solving problems than non-gifted students (Yıldız, Baltacı, Kurak, & Güven, 2012). Because gifted students think that problem posing is difficult and they state that they are more comfortable solving problems than problem posing (Manuel & Freiman, 2017). This situation is confirmed by the fact that the gifted students reached in the study are more successful in solving the problem they posed than the non-gifted students and more unsuccessful in solving the problem they posed than the non-gifted students and more unsuccessful in solving the problem they posed that they are mentally tired when the non-gifted students. The reason why gifted students who excel in creativity and motivation (Leana-Taşcılar & Cinan, 2012) fail to pose structured problems compared to non-gifted students may be that they are mentally tired when they come to the Science and Art Centers to receive education after their normal education. This mental fatigue may reduce their motivation, prevent them from concentrating on the subjects, and make them reluctant to attend classes. The inability of gifted students with creativity to focus their attention on the subject; they may find it simple to change only the numbers given in the problem situation or the appropriate expression for the situation, thus hindering their efforts to make the problem more creative by differentiating it.

Recommendations

1. Dialogic reading or computer-assisted problem-posing activities can be done to improve structured problem posing skills, which are more unsuccessful for gifted students than free and semi-structured problem-posing.

2. Since gifted students pose problems that require fewer steps in free and semi-structured problem-posing compared to non-gifted students, mind and intelligence games activities can be organized to improve the high-level thinking skills of gifted students.

3. Problem-posing activities can be increased in order to improve the problem posing skills of students in classes where gifted and non-gifted students study together.

Author (s) Contribution Rate

Authors contributed equally to the study.

Conflicts of Interest

There is no conflict of interest for individuals or institutions in this research.

Ethical Approval

Ethical permission (17.06.2022-E-81614018-000-2200023344) was obtained from Trabzon University institution for this research.

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Distance Education from Teacher and Learner Perspective

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Distance Education from Teacher and Learner Perspective

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Abstract

This study aims to determine the views of individuals who have experienced the distance education process as both students and teachers. The study group consists of individuals who both enrolled in graduate education programs at a state university and taught actively at K-12 institutions. The study is conducted with a phenomenological design. The Miles Huberman model was used in the analysis of the data. The problems faced by the participants in the distance education process, in which they took part both as teachers and students, were grouped under "instructor dimension, student dimension, family dimension, infrastructure, hardware, and physical environment dimension, social interaction dimension, and process dimension". The views of the participants on the assessment and evaluation processes in distance education systems, other factors that affect evaluation, negative situations, and positive situations". The same sub-themes occurred, except for "positive situations", when the views on assessment and evaluation processes in distance education were grouped under "technical knowledge, knowledge of instructional design, social skills, knowledge of pedagogical content, management skills, and knowledge of assessment and evaluation".

Keywords: Distance education, E-teacher competencies, Graduate student, K-12 teacher, Problems in distance education

Introduction

Distance education has been the most effective solution to continue learning and teaching with the COVID-19 pandemic. Institutions, educators, and students have experienced an unexpected and forced transition from face-to-face teaching to distance education. As a result, distance education has become a form of education experienced by the majority of educators and students.

Distance education is a planned learning process in which teachers and students are in different environments, communication is provided with technological tools, and special arrangements are made for teaching (Moore & Kearsley, 2011). Distance education is the separation of the environment in which the learning process takes place (Larreamendy-Joerns & Leinhardt, 2006). Distance education's main goal is to make educational opportunities accessible to students who are not close to educational institutions and instructors.

Distance education can be performed synchronously or asynchronously. Synchronous education refers to the simultaneous exchange of information, usually through real-time online lectures, webinars, or video conferences, and therefore more closely reflects traditional teaching methods (Gurung & Stone, 2020; Mladenova et al., 2020). Comparatively, asynchronous education is self-advancing and therefore takes place independently of the participation of other students and educators (Nordmann et al., 2020). Distance education offers many advantages to individuals due to its diverse feature set, which includes access to various types of information, space and time flexibility, the utilization of different methods and techniques to structure the information, and flexibility in adjusting the learning pace (Woodard, 2003).

An effective distance education activity should be a successful system that responds to the needs of students (Bates, 2019). The learning management system used in distance education consists of a virtual classroom, e-content, e-teacher, e-student, and assessment and evaluation components. These components come together with their unique features and form an integrated structure. The trainer's mastery of the distance education system will make it easier for him or her to organize and run the system. An instructor in distance education should organize

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the lesson in accordance with virtual environments, identify the needs of students in virtual classrooms, use methods and techniques suitable for digital environments, make assessments and evaluations, and teach their lessons interactively and with feedback.

In the distance education literature, studies are conducted on institutional support (Marshall, 2012; Naylor & Nyanjom, 2021), technical support (Gunn, 2010), interaction (Bernard et al., 2009; Horzum, 2013), effectiveness of distance education strategies (Barton, 2020; Gurung & Stone, 2020), problems experienced in the transition to distance education in different countries (Chiemeke & Imafidor, 2020; Mailizar et al., 2020), students' perceptions of learning materials, peers, and teachers (Eom & Ashill, 2016; Hsieh Chang & Smith, 2008; Parahoo et al., 2016; Weidlich & Bastiaens, 2018), and comparison of student satisfaction in distance education and face-to-face education (He et al., 2021; Yen et al., 2018)

Education is a phenomenon that needs to be constantly evaluated and updated. Therefore, educational practices should be evaluated by policymakers and education administrators, and their shortcomings should be addressed. By doing so, similar problems will be averted in distance education processes. Otherwise, these shortcomings will lead to learning losses. The current study examines the views of individuals who have experienced the distance education process as both students and teachers. In this context, the opinions of the participants about the problems they encounter in the distance education process, the assessment and evaluation processes in distance education, and the e-teacher competencies for an effective distance education process are investigated. This will make it possible to identify problems that arise during the distance learning process and find solutions. The obtained results will contribute to the improvement of distance education activities. This study is significant for all of the aforementioned reasons.

In the current study, the opinions of individuals who both teach in K-12 institutions and receive postgraduate education during the distance education process were consulted. It is expected that the obtained results will create awareness about the problems experienced by academicians and teachers. The participants' simultaneous experience of the distance education process as both students and teachers will enable them to evaluate the education process critically and from different perspectives. Another important aspect of the current study is that it will enable people, who are actively involved in the process as both students and teachers to evaluate themselves. Thus, individuals will be able to make self-evaluations by analyzing their behaviors and thoughts on the relevant subject (Bruhn et al., 2015). Self-assessment is a process in which teachers evaluate their knowledge, performance, beliefs, and competences (White, 2019). Self-assessment contributes to the professional development of teachers (Ross & Bruce, 2007). Self-assessments enable identifying good and bad practices in distance education.

Distance education instructors should gain awareness of the planning, design, and execution of the education process. The current study is important for educators to gain awareness of trainer competencies in an evolving digital world. The findings related to teacher competencies in distance education can be described as a need assessment study for teacher education programs. Within the scope of the current study, the following questions were asked of participants:

- 1. Can you explain the problems you encountered as a teacher during the distance education process?
- 2. Can you explain the problems you encountered as a student during the distance education process?
- 3. As a student, can you share your views on evaluation processes in distance education?
- 4. As a teacher, can you share your views on evaluation processes in distance education?
- 5. Can you share your views on the competencies that an instructor should have in an effective distance education process?

Method

Research Design

The phenomenology pattern, which is part of the qualitative research method, was used in the current study. Phenomenology is a pattern that allows people to express their thoughts, perceptions, perspectives, and feelings about a certain concept or phenomenon and is used to express how they experience this phenomenon (Rose et al., 1995; van Manen, 2016). The phenomenology design was considered appropriate because this study aims to examine the experiences of the participants as teachers and students.

Participants

The participants were chosen using criterion sampling, one of the purposive sampling methods. Criteria-based sampling is the inclusion of situations that meet the determined criteria to reach the best data sources suitable for the research (Patton, 2014). The participants were chosen based on the criterion that they simultaneously participated in the distance education process as both students and teachers. The study group consists of individuals enrolled in a graduate education program at a state university in the spring semester of the 2020-2021 academic year and actively teaching at K-12 institutions in the same period. The participants were coded starting from P1 to P14. Information about the study group is presented in Table 1.

Gender	Age	Seniority	Branch
Female	28	5	Maths
Female	37	15	Technology and Design
Male	42	5	Social Sciences
Male	28	4	Maths
Female	29	5	Turkish language
Male	28	3	Science
Female	26	4	English language
Female	27	4	English language
Female	26	4	English language
Male	25	1	Elementary school
Female	30	5	Social Sciences
Male	28	5	Maths
Female	39	15	Elementary school
Male	40	4	Religious education

Table 1. Information on the study group

Table 1 shows that 6 of the participants are male and 8 are female, with ages ranging from 25 to 42. Of the participants who teach in K-12 institutions, 3 are math teachers, 3 are English language teachers, 2 are social sciences teacher, 1 is a technology and design teacher, 1 is a Turkish language teacher, 1 is a religious education teacher, and 1 is a science teacher.

Data Collection Tool and Data Collection

A semi-structured interview form is used in the current study. Initially, a draft form was created in line with the data obtained from the literature. According to the recommendations of two experts in the fields of distance education and language, the form was reviewed for clarity, adequacy, and suitability of the questions, and any necessary changes were made. A pilot study was performed with two participants, who fit the criteria but were not part of the study to determine the clarity of the questions. After the pilot application, the questions were revised, and the final form of the interview form was established. Interviews were conducted with 14 voluntary participants. The participants were informed about the purpose of the research before the interview. It was explained to the participants that they could discontinue the study without any responsibility, that their identity information would be kept confidential in the research results, and that the results would only be used for scientific purposes. Interviews started in October 2021 and were completed in December 2021. Interviews lasting 30-40 minutes were conducted with the participants on the days and hours they chose, and their perspectives on the topic were attempted to be examined in depth.

Analysis of Data

The Miles-Huberman qualitative analysis model was used in the analysis of the data (Miles & Huberman, 1994). Miles - Huberman model can be defined as three parallel flows of activities, namely, data reduction, data display, and conclusion drawing or verification. The stages of the Miles Huberman model are given in Figure 1.



Figure 1. Miles-Huberman's components of data analysis

To ensure validity and reliability in qualitative research, it is necessary to explain the data collection and analysis process in detail, to extract the coding key, to create the themes based on the coding key, and to calculate the consistency between the coders. In this context, the steps followed in the process of collecting and analyzing data should be explained in detail (Rourke & Anderson, 2004).

Coding can be reviewed by the same coder 10-14 days later, after the analysis of qualitative data, to guarantee the consistency of the results. (Flick, 2014). The analyses were repeated 10 days later to ensure coding reliability. Miles & Huberman's (1994) reliability formula (consensus / (consensus + disagreement)) was used to calculate the reliability coefficient between the two encodings. The coding consistency was calculated as 92%. In addition, credibility is maintained by making direct quotations from the obtained interview texts (Creswell & Creswell, 2017; Johnson & Christensen, 2019). Direct quotes from participants are kept anonymous, and individuals are coded as 'P+Number' within the context of study ethics. To ensure external validity, the research design, study group, data collection tool, data collection, data analysis, and organization of the findings were described in detail. Additionally, the participants of the study were selected from suitable individuals who would contribute to the purpose of the study.

Findings

The problems encountered as a teacher during the distance education process

The participants were asked about the problems they encountered as teachers during the distance education process, and the findings are presented in Table 2.

Theme	Sub Theme	Code	f
		Inability to adapt methods and techniques to online environments	7
		Inexperience in preparing lesson plans, content, and materials	6
		Difficulties in identifying student learning needs	5
	T , ,	Difficulties in ensuring active participation of the students in class	5
	Instructor	Inexperience in assessment and evaluation in distance education	5
	uniclision	Difficulties in providing student motivation in virtual classrooms	4
Problems		Lack of motivation caused by impossibilities	4
		Lack of knowledge about infrastructure and hardware usage	4
encountered in distance		Other responsibilities at home (like taking care of children and cooking)	3
education	Student dimension	Students' lack of active participation in the class	8
as a teacher		Absenteeism problems in education	8
		Quick distraction in front of the screen	5
		Lack of motivation in students	5
		Decrease in time allotted to education due to responsibilities at home	4
		The emergence of inequalities of opportunity among students	4
		Pessimism caused by inequality of opportunity in students	4
_		Lack of knowledge about infrastructure and hardware usage	4
-	Family	Families assigning children different responsibilities at home	3

Table 2. The problems encountered as a teacher during the distance education process.

dimension	dimension Lack of interest by families in their children's education process	
	Family pressure put on children	3
	Intervention of families in educational planning	2
	Internet connection problems	9
Infrastructure,	Lack of hardware and hardware malfunction	9
hardware and	Lack of a physical environment suitable for live lessons at home	6
environment	Systemic errors	5
dimension	Browser problems	5
	Network problem for mobile devices	3
	Insufficient interaction	7
Social	Uncertainty of the boundaries of private life	4
interaction	The discomfort of being constantly called by students and parents	3
dimension	Inability to establish healthy dialogues	3
	Social skill development is not supported	2
Process	Stressful conduction	4
dimension	Tiresome conduction	4

According to Table 2, the problems that the participants face in distance education as teachers are grouped under the sub-themes of instructor dimension (9 codes), student dimension (8 codes), family dimension (4 codes), infrastructure, hardware, and physical environment dimension (6 codes), social interaction dimension (5 codes), and process dimension (2 codes). The statements of some of the participants are as follows:

P1: Since distance education is a situation that I have encountered for the first time, I had difficulties in preparing the lesson plan, content, and material...

P2: The biggest problem I faced as a teacher was the low participation of our students...

P4: It was not possible to establish a healthy dialogue with the students...

P6: In distance education, every student had our number, and every parent was able to call us at any time. It never occurred to any parent that we also have a family and that they cannot call us whenever they want...

P9: I did not have the necessary device and internet infrastructure to teach the math lesson. (I think a tablet and a PC pen are needed.) Typing with a mouse on the PC was causing a waste of time and a disorganized screen display....

P10: In my opinion, the lack of a social dimension to learning in online learning environments and students' motivation problems were among the biggest problems...

P14: Of course, we had problems due to our lack of knowledge of distance education. During the graduate process, I saw that many of our professors who have been in the academy for many years also experienced the problems we experienced, and this situation negatively affected the efficiency of the lesson in every sense...

The problems encountered as a student during the distance education process

The participants were asked about the problems they encountered as students during the distance education process, and the findings are presented in Table 3.

Table 3. The	problems encountered as a st	udent during the	distance education	process
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Theme	Sub Theme	Code	f
Problems	T , ,	Inexperience in assessment and evaluation in distance education	6
encountered in distance	Instructor	Inadequate planning of the education process	6
	dimension	Lack of motivation in virtual classrooms	4

education as a student	-	Failure of the instructor to use different methods and techniques in the class	4
		Instructor not starting the course on time	4
		The instructor's failure to prepare the physical environment and equipment before the class	4
		The instructor's inability to use digital technologies properly	3
		Lack of knowledge about infrastructure and hardware usage	3
		Quick distraction in front of the screen	5
	Student	Lack of knowledge about infrastructure and hardware usage	4
	dimension	Physical discomforts caused by constantly sitting in front of the screen	4
		Having to learn most things by his or her own effort	4
	Infrastructure, hardware, and	Internet connection problem	6
		Browser problems	4
		Lack of hardware and hardware malfunction	4
	environment	Systemic errors or deficiencies	4
	dimension	Network problem for mobile devices	3
		The unsuitability of the home environment for listening to lectures	3
	Social	Insufficient interaction	8
	interaction dimension	Instructor's unwillingness to communicate with students outside of the class	5
	Process	Stressful conduction	5
	dimension	Tiresome conduction	3

According to Table 3, the problems that the participants face in distance education as students are grouped under the sub-themes of instructor dimension (8 codes), student dimension (4 codes), infrastructure, hardware, and physical environment dimension (6 codes), social interaction dimension (2 codes), and process dimension (2 codes). The statements of some participants were as follows:

P2: The most important problem I faced as a student was communicating with our teachers. We, who are in the status of teachers, had to apply to second or, in some cases, third parties in order to communicate with our instructors as students...

P3: Quick distraction while listening to lectures and the unsuitability of my home environment for listening to lectures were pushing me hard...

P5: As a student, I had a hard time as some of the lecturers did not attend the class on time, did not lecture fluently, and microphones or materials were not ready. In addition, the process would be much easier if notifications such as "your exams are now uploaded to the system" and "homework has been given" were sent to the students as a message...

P7: The eye and back pain caused by looking at the screen for long hours had a negative effect on me. Systemic problems made communication difficult during the course...

P10: The fact that the majority of our instructors were quite unfamiliar with distance education was an important problem in terms of the efficiency of the lessons...

Views on assessment and evaluation processes in distance education as a student

Participants were asked for their opinions on the assessment and evaluation processes in distance education as students, and the findings are presented in Table 4.

Table 4.	Views on assessment	and evaluation proce	esses in distance e	education from	a student pers	pective

Theme	Sub Theme	Code	f
Assessment	Measured learning	Cognitive gains at the knowledge level	7
and evaluation	outcomes	High-level cognitive gains	2

in distance education from a student perspective		Homework report	11
		Online discussions	5
	Assessment and	Presentation	4
	e valuation tools	Project	2
		Exam	2
-	Assessment and	Result oriented	9
	evaluation system	Process oriented	3
-	Other factors that affect	Student attendance	4
	the evaluation	Instructor's prior knowledge of the student	2
-		Invalid and unreliable assessment and evaluation	6
		Unclear boundaries and wide scopes of the homework	6
		Unclear and incomprehensible homework or exam instructions	4
		Failure to identify learning deficiencies	4
	Negative situations	Homework upload/download problems due to systemic deficiencies	4
		Formation of learning deficiencies due to a lack of feedback	4
		Inadequate planning or uncertainties in the process	4
-		Technical problems in online exams	2
	Positive situations	Contribution of homework that requires high-level skills to learning	4
		Being efficient in terms of learning to learn	2

According to Table 4, the views on assessment and evaluation processes in distance education as a student are grouped under the sub-themes of measured learning outcomes (2 codes), assessment and evaluation tools (5 codes), assessment and evaluation systems (2 codes), other factors that affect the evaluation (2 codes), negative situations (8 codes), and positive situations (2 codes). The statements of some participants were as follows:

P4: Since the evaluations are made with homework, I think that it is inadequate to measure whether the information is actually gained or not...

P5: Evaluations were made with assignments. Some of the assignments were rote-based and meant only for writing and sending, so they didn't make any sense...

P7: Evaluations in the distance education process were made through class participation, in-class presentations, and research assignments. Research assignments have been fruitful for my personal development and ability to learn...

P8: I think that the evaluations are invalid and unreliable. The lack of planning for assessment and evaluation and the uncertainties in the process created stress for us...

P10: The fact that the evaluation processes are not well planned and the technical problems experienced during the online exams are among the problems I see...

P11: A process-oriented evaluation was made, and discussion environments that required high-level interpretation skills contributed to learning...

P13: Most of the courses were evaluated with the homework uploaded to the system. I think the evaluations made did not reflect the truth in any way...

Views on assessment and evaluation processes in distance education as a teacher

Participants were asked for their opinions on the assessment and evaluation processes in distance education as teachers, and the findings are presented in Table 5.

Theme	Sub Theme	Code	f
	Measured learning	Cognitive gains at the knowledge level	5
	outcomes	High-level cognitive gains	2
		Online discussion	5
	Assessment and	Exam	5
	e valuation tools	Homework	2
Assessment and evaluation in – distance	Assessment and evaluation system	Result oriented	9
		Process oriented	5
	Other factors that affect the evaluation	Student attendance	4
education		Student success before distance education	3
from a teacher		Inability to make in-class assessments due to lack of regular attendance to classes	6
perspective		Failure to identify learning deficiencies	5
	Nagetive situations	Invalid and unreliable assessment and evaluation	4
	Negative situations	Inexperience in assessment and evaluation in distance education	4
		The pressure created on the students by the uncertainties in the assessment and evaluation processes	4
		Difficulties in accessing assessment and evaluation materials	3

Table 5. Views on assessment and evaluation processes in distance education from a teacher's perspective

According to Table 5, the views on assessment and evaluation processes in distance education as a teacher are grouped under the sub-themes of measured learning outcomes (2 codes), assessment and evaluation tools (3 codes), assessment and evaluation systems (2 codes), other factors that affect the evaluation (2 codes), and negative situations (6 codes). The statements of some of the participants are as follows:

P2: Especially in my field of technology and design courses, we have never had the chance to learn face-to-face. We had to evaluate according to class participation...

P5: Since I could not take a face-to-face exam, I graded my students according to criteria such as attending live classes, answering the questions in the lesson, and doing the homework given...

P7: I made the evaluations considering the previous performances of the students since they did not attend the classes or could not attend the classes...

P8: During the pandemic, I had great difficulties in the evaluation processes because I had no experience in assessment and evaluation in distance education...

P12: It is impossible for me to talk about a healthy evaluation since we did not receive training on measurement and evaluation in distance education...

Views on the competencies that an instructor should have in an effective distance education process

The participants were asked for their opinions on the competencies that an instructor should have in an effective distance education process, and the findings are presented in Table 6.

Theme	Sub Theme	Code	f
	Measured learning	Cognitive gains at the knowledge level	7
	outcomes	High-level cognitive gains	2
Assessment and		Homework report	11
evaluation in distance education from a student perspective	Assessment and evaluation tools	Online discussions	5
		Presentation	4
		Project	2
		Exam	2
	Assessment and	Result oriented	9
	evaluation system	Process oriented	3

Table 6. Views on the competencies that an instructor should have in an effective distance education process

Other factors that	at Student attendance	
affect the evaluation	Instructor's prior knowledge of the student	2
	Invalid and unreliable assessment and evaluation	6
	Unclear boundaries and wide scopes of the homework	6
	Unclear and incomprehensible homework or exam instructions	4
Nagative situations	Failure to identify learning deficiencies	4
Negative situations	Homework upload/download problems due to systemic deficiencies	4
	Formation of learning deficiencies due to a lack of feedback	4
	Inadequate planning or uncertainties in the process	4
	Technical problems in online exams	2
	Contribution of homework that requires high-level skills to	4
Positive situations	learning	4
	Being efficient in terms of learning to learn	2

According to Table 6, the views on assessment and evaluation processes in distance education as a teacher are grouped under the sub-themes of technical knowledge (6 codes), knowledge of instructional design (3 codes), social skills (6 codes), knowledge of pedagogical content (11 codes), management skills (3 codes), and knowledge of assessment and evaluation (2 codes). The statements of some participants were as follows:

P1: Since the learner is alone in front of the screen in distance education and it is not possible to control what he/she is doing, the instructor must carry out the process in a way that will attract the student's attention to the lesson...

P3: Unfortunately, not every student has the same conditions. Therefore, the teacher should be able to provide flexibility in some aspects, taking the student's conditions...

P5: First of all, trainers should be able to use information technologies such as computers, tablets, and phones well...

P7: A lesson plan should be prepared by being aware of individual learning skills and developmental periods. It should be progressed according to the level of the students...

P8: In the distance education process, an instructor should be able to prepare digital content and have a good grasp of the distance education platform used...

P10: One of the characteristics that a teacher should have in the distance education process is the ability to provide flexibility to students and to empathize with them.

Results and Discussion

In the current study, the problems encountered by the participants in the distance education process in which they took part as teachers were grouped under the sub-themes of "instructor dimension, student dimension, family dimension, infrastructure, equipment, and physical environment dimension, social interaction dimension, and process dimension".

Within the literature, the problems related to distance education processes are described as the inability to carry out the practical courses with the desired efficiency, a lack of interaction, the inability to provide adequate support for assessment and evaluation processes' academic development of students, the inability to provide instant feedback to students, educators lack of skills for distance education, and the inadequacy of infrastructure services (Koç, 2021; Oliveira et al., 2018). Active online learning processes tailored to the interests and requirements of the learners are required in distance education to address the deficiencies mentioned and increase interaction. For this, active learning methods and techniques and different digital materials should be used. The use of various technologies will guarantee active student participation and improve learning interactions.

In terms of effectiveness, the distance education process is generally associated with interaction. (Simpson & Anderson, 2012). There is a directly proportional relationship between interaction and students' success in distance education (Cheng & Chau, 2016). To increase the interaction in distance education applications, online learning experiences should be used (Salmon, 2013). The interaction and cooperation between the learner-learner

and the learner-teacher must be supported by technology-based applications. Technology-based research-learning communities that support knowledge sharing, knowledge exchange, and development make the learning process efficient and effective for all stakeholders (Van Weert, 2006). Educators can create virtual communities for this purpose. The main purpose of creating these communities is to prevent students from being isolated and help them feel connected to each other, to the educator, and to the learning community (Gohl, 2020).

The learning and teaching process needs to be organized in a way that appeals to students with different learning styles. In addition, the learner needs to switch from the passive participant role to the active learner role, to actively experience the learning process, which will ensure efficiency in education. Some of the targeted gains may not be achieved during the learning process. Identifying these deficiencies is among the duties of the teacher. Identifying these deficiencies in distance education may be more difficult than in face-to-face education. In fact, participants claimed that it is difficult to determine the learning needs of students in distance education.

Individuals studying in distance education find learning environments that allow learner-teacher, learner-learner, and learner-content interaction enjoyable. Making learning enjoyable increases the student's motivation (Holmberg, 2005). In distance education, students are open to external stimuli in their environment. For this reason, they may lose their interest in the lesson, their concentration may deteriorate, and they may experience motivational problems. In the current study, it was found that the instructors had difficulties providing student motivation in virtual classrooms.

In the current study, the participants stated that the students did not actively participate in the lesson and that they had absenteeism problems. For the continuity of the learning process in distance education, learners should be integrated with peer groups, academic systems and social systems. The interaction provided in online course processes is highly effective in fostering the learner's desire to continue online courses (Croxton, 2014). To increase interaction, the instructor must be accessible to the students and guide them. Another important issue identified in this research is the uncertainty of the private lives of the instructors in the distance education processes. Distance education has made the boundary between family time and work time more permeable than ever before (Mesch, 2006).

Some problems that teachers encountered during the distance education process were found to be grouped under the subtheme of "student dimension". Some of the characteristics that learners must have in order to be successful in distance education are stated as being able to learn with limited support, managing time, communicating with instructors online, frequently checking e-mail, having self-confidence, communicating with other learners online, using technology at a basic level, and having self-discipline (Beaudoin et al., 2009). The features of learners, such as technology self-efficacy and self-regulation skills, can be effective for learning outcomes in distance education (Wang et al., 2013).

In the current study, the problems encountered by the participants in the distance education process in which they took part as students were grouped under the sub-themes of "instructor dimension, student dimension, family dimension, infrastructure, equipment, and physical environment dimension, social interaction dimension, and process dimension". In the literature, it is stated that students experience difficulties such as independent learning, time management, maintaining motivation, and problems such as accessibility, the digital divide, and inequality in the online learning process (Lee et al., 2021; Shin & Hickey, 2021).

Under the sub-theme of the "instructor dimension" from the student's point of view, the following codes are found: Inexperience in assessment and evaluation in distance education, inadequate planning of the education process, lack of providing motivation in virtual classrooms, failure of the instructor to use different methods and techniques in the class, the instructor not starting the course on time, the instructor's failure to prepare the physical environment and equipment before the class, the instructor's inability to use digital technologies properly, and a lack of knowledge about infrastructure and hardware usage are among the reasons for this failure. Since there is no physical interaction in distance education, students may feel lonely and distracted during the class. In order to prevent this, students' attention should be drawn to the lesson, and students should be motivated by interacting with them. Drawing attention to the subject of the class and explaining the importance of the lesson will have a positive effect on the students to attend the class, different visuals and humorous elements can be used, and discussion environments can be organized. Furthermore, considering the process of distance education.

Assessment and evaluation are two of the most important components of education. The assessment and evaluation process allows for evaluating the learning levels of students, identifying learning difficulties, and

making necessary improvements. In the current study, the opinions of the participants about the assessment and evaluation processes in distance education as students were gathered under the sub-themes of measured learning outcomes, assessment and evaluation tools, assessment and evaluation systems, other factors that affect the evaluation, negative situations, and positive situations. When the views on assessment and evaluation processes in distance education are examined from the teacher's perspective, the sub-themes are found to be similar, except the "positive situations" sub-theme does not occur.

Participants talked about similar situations regarding learning outcomes measured in assessment and evaluation from the perspective of both students and teachers. It has been found that the learning outcomes measured from both student and teacher perspectives are mostly cognitive gains at the knowledge level. The majority of the participants stated that the behaviors in the lower levels of Bloom's taxonomy were measured. However, according to the digital bloom taxonomy, assessment and evaluation of all stages of the cognitive field are possible. That is in remembering steps, short-answer tests, multiple-choice tests, poster presentations, and lectures; in comprehension steps, written reports, multiple choice tests, short answer questions, summaries, poster presentations, comparisons, and discussions; in analysis steps, diagrams, role-playing, following directions, simulations, projects, case studies, surveys, discussions, and graphics; in evaluation steps, generating hypotheses, projects, creative activities, articles, and simulation; in creation stages, projects, case studies, criticisms, and self-evaluations are suggested (Churches, 2008). Handling and implementing the specified activities holistically will increase the efficiency of the assessment and evaluation process in distance education.

In the current study, it was discovered that both traditional and non-traditional tools were used for assessment and evaluation in distance learning. In distance education, alternative methods based on the constructivist approach (such as product files, performance evaluation, and projects) should be given more place instead of traditional measurement tools (classical written exams, multiple choice, essay writing, true-false exams, and filling in the blanks) (Simonson et al., 2019). Additionally, assessments can be made using self and peer assessments (Alvarez et al., 2012), online discussions (Kent et al., 2016), feedback, and students' learning analytics (Nyland et al., 2017). However, it is possible to say that designing and implementing online assessment in general is a difficult topic (Atherton et al., 2017).

From the student's point of view, the "assessment and evaluation tools" sub-theme includes "homework report, online discussions, presentation, project, and exam" codes, while the "assessment and evaluation tools" sub-theme from the teacher's perspective includes "online discussion, exam, and homework" codes. Homework and online discussions were found to be the most preferred assessment and evaluation tools. Participants stated that homework that requires high-level skills contributes to learning and is productive in terms of learning to learn. Participants stated that result-oriented evaluations were carried out heavily in distance education.

The feedback used in distance education is very important for the students. Feedback greatly contributes to students' ability to organize and control their own learning experiences and gain autonomous learning experiences (Evans, 2013; Price et al., 2010). Feedback can add new information to individuals' knowledge, confirm their existing thoughts, reconstruct their existing knowledge, or correct their misunderstandings (Peterson & Irving, 2008). Therefore, it is possible to say that feedback has a formative role (Alvarez et al., 2012). When students do not get feedback, they might assume that their instructors are not concerned with their performances in the learning environment (Miller & King, 2003). Due to this reason, students may become disinterested in the lesson, lose the desire to learn, and become less motivated. Positive feedback increases the motivation of individuals to realize their potential. It is possible to ensure the realization of permanent learning with didactic feedback.

In the current study, it was found that the assessment and evaluation process is an important issue that needs to be improved from the perspective of both the student and instructor. It was stated that assessment and evaluation in distance education are invalid and unreliable from both the teacher's and student's points of view. It is also found that the instructor's knowing the student beforehand and the student's attendance status are factors affecting the evaluation process. The inability to comprehensively measure the post-training learning outcomes of distance education students, the lack of use of different assessment and evaluation tools, and the lack of systematic assessment and evaluation may have negatively affected trust in the assessment and evaluation process. Using different assessment and evaluation techniques in distance education and making process evaluations rather than product evaluations will increase confidence in assessment and evaluation.

Successful distance education instructors should be aware of the similarities and differences between face-to-face and distance education and apply this knowledge to the distance education process. (Palloff & Pratt, 2011). In order for distance education to be effective and successful, instructors must have some qualifications. Teacher competencies for e-learning processes, which are based on technology, are defined as e-teacher competencies or

online teacher competencies. Some researchers rank online competencies as personal, social, pedagogical, and technological (Baran & Correia, 2014; Guasch et al., 2010). Bailie (2011) listed the most preferred competencies as content, feedback, social, and managerial. Outcomes of the current study indicate the competence areas that teachers should have as technical knowledge, knowledge of instructional design, social skills, knowledge of pedagogical content, management skills, and knowledge of assessment and evaluation.

In order for the distance education process to be successful, the instructor must have sufficient knowledge about distance education. In distance education processes, instructors should perform different actions, such as adapting their pedagogical knowledge to online environments, using technology effectively, and transferring content to digital environments. It is stated that online instructors should have pedagogical, content, design, technological, social, and communication skills (Albrahim, 2020). Additionally, instructors should design teaching methods and strategies suitable for live class processes in line with pedagogical principles and organize activities to increase the motivation of learners (Bawane & Spector, 2009; Kassandrinou et al., 2014; Roblyer & Doering, 2013).

The activity development skill of the instructor is very effective in increasing the quality of distance education (Lerra, 2014). In order to meet the needs of learners with different learning levels and styles in distance education, instructors need to design and use interactive activities, solve problems that online students may encounter, and improve their technical skills (Martin & Parker, 2014). Gagne's nine-step model for teaching is one of the most accepted proposals for the design of distance education course activities (Reisner & Dempsey, 2021). The first three steps of the Gagne model consist of suggestions for attracting attention, communicating goals, and linking previous learning. Studies showed that these suggestions could be taken as a basis for evaluating the classes (Martin et al., 2004; Uğraş et al., 2016).

The materials prepared according to the objectives of the course are essential for the effective and efficient execution of the distance education process. The instructor should be able to prepare digital content or reach digital content suitable for the purpose. Using materials in distance education can guide the teacher to conduct the process well and enable the students to focus their attention and make what they learn permanent. However, the material used should be suitable for the objectives of the course and the level of the student, enriched with visuals, remarkable, and up-to-date. These materials can be used for different purposes, such as informing the student about what to do in the lesson beforehand, gaining the student's attention during the lesson, helping the student make sense of the subject, and reinforcing the subject and giving feedback after the lesson.

Educators should be able to take learning to higher levels by using the techniques most suitable for student characteristics and learning goals (Koç, 2021). It is recommended to use the Digital Bloom Taxonomy in the gradual classification of learning in distance education. Churches (2008) updated the Bloom Taxonomy to create this taxonomy for use in distance education procedures. The Digital Bloom Taxonomy contains important clues to strengthen and enrich the processes of distance education. It also guides educators in reflecting practice-based courses in distance education on the processes. According to this taxonomy, activities such as making virtual presentations, sharing documents, and conducting virtual interviews can be done in the application step. In the analysis step, activities such as creating a network, preparing panels, doing research, and conducting peer evaluation activities via blogs or wikis can be achieved. At the highest level of creation, activities such as making a programming language can be included.

Evaluating the results of the current study in general, it is seen that a successful education and training process is directly related to the competencies of the instructor. A high level of interaction between the learner and the teacher can be achieved through the instructors' knowledge and practice of distance education competencies. In this manner, communication problems during the learning process will be avoided. Students will have a positive attitude and motivation toward the distance education process. Thus, an effective education will be realized.

Suggestions

- Seminars on lesson planning, content, material preparation, assessment, and evaluation processes should be given to distance education educators. Training activities for instructors organized for distance education should be widespread and continuous.
- In-service training should be given at regular intervals to overcome the problem of instructors adapting to digital environments.

- To increase the effectiveness of the education process, the usage of different educational materials should be ensured.
- Applications such as chat rooms and discussion groups should be used to ensure interaction in distance education.
- In order to increase the efficiency of distance education, studies should be conducted to increase the selfcontrol skills of learners who are not in the same environment as the instructor.
- The assessment and evaluation process should be clearly explained to the student, and the student's anxieties regarding the assessment process should be reduced.
- Evaluation criteria should be shared with students to ensure confidence in the assessment and evaluation processes.
- Information guides should be prepared for students about the exam systems to be used in distance education.
- Assessment and evaluation tools used in distance education should be diversified.
- Assessment and evaluation activities in distance education should be brought to a level that will allow the development of high-level thinking skills in 21st century learners.
- The validity and reliability of the measurement tools used in distance education should be increased.
- In distance education, not only result-oriented but process-oriented evaluations should be made.

Conflicts of Interest

No potential conflict of interest was reported by the author(s).

Ethical Approval

Ethical permission (21.10.2021-161) was obtained from Dicle University Ethics Committee for this research.

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A Mixture Rasch Model Analysis of Data from a Survey of Novice Teacher Core Competencies

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A Mixture Rasch Model Analysis of Data from a Survey of Novice Teacher Core Competencies

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Abstract

Although the Rasch model is used to measure latent traits like attitude or ability where there are multiple latent structures within the dataset it is best to use a technique called the Mixture Rasch Model (MRM) which is a combination of a Rasch model and a latent class analysis (LCA). This study used data from a survey for teachers, teacher candidates, and teacher education program faculty with a sample of 296 candidates, 648 graduates, and 501 program faculty. Survey items based on these competencies were administered to in one Western state to ascertain how well the program candidates attended prepared them for the teaching profession. The 40 items common to surveys of the three groups were submitted to mixture Rasch analysis to determine whether distinct patterns of item response were discernible. Analyses yielded two classes which brings the construct validity of the survey into question. Results showed that the Mixture Rasch Model is and can be useful to determine sub-groups for survey researchers. This research presents a demonstration of usefulness of the Mixture Rasch Model for the analysis of survey data.

Keywords: Mixture rasch model, Validity, Survey research, Teacher effectiveness

Introduction

The mixture Rasch model was first introduced by Rost in 1990. The model was proposed to create a combination of the Rasch model with latent class analysis. Main assumption is that Rasch model holds for all participants within a latent class, but it allows for different sets of item parameters between the latent classes (Rost, 1990). As a result of this, the model might be applied to validate responses to a test or questionnaire. Since the Rasch model has some strict item and homogeneity assumptions, the MRM becomes useful when some item and population homogeneity assumptions are relaxed. If it is known that there are heterogeneous structures in the population, a single population assumed statistical model might not produce valid results (Sen, 2016).

Basically, mixture Rasch models are a combination of two models: a Rasch model a latent class analysis model (Kaiser & Keller, 2001). One main advantage of this useful combination is unlike the quantitative information provided by Rasch models, mixture Rasch models supply information about quantitative and qualitative structures within the dataset. If there are multiple latent structures within the dataset traditional IRT models may produce biased results. However, the mixture Rasch model overcomes this issue and becomes handful. Mixture Rasch models can detect participant heterogeneity and the related item structures, the size of latent classes, and the latent score distribution (Baghaei & Carstensen, 2013). MRM not only detects the subclasses based on qualitative information but also invastigates quantitative information about the sample and the scale used for data collection (Sen, 2016). Another advantage of MRM is when researchers think that participants use different strategies or there are instructional differences, curriculum etc. or a model including additional factors of quantitative differences within strategies MRM becomes more useful (Toker & Green, 2021).

MRM is primarily utilized to investigate individual variations in strategy usage and knowledge disparities, as well as to explore unidimensionality and validation (Baghaei & Carstensen, 2013). When data fails to conform to the typical unidimensional Rasch model, MRM identifies the subgroups or latent classes within the entire sample that adhere to the Rasch model. These subgroups are, in essence, the latent classes that differ qualitatively. MRM identifies subgroups with DIF, rather than conducting DIF across manifest variables such as sex or native language (Pishghadam et. al., 2017). Once latent classes are identified, the content of the items must be scrutinized to determine the nature of the qualitative distinctions between the classes that caused the DIF. The subsequent step

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is to examine the nature of the classes and establish how they vary. In other words, class membership should be associated with some qualitative differences in test-takers. Such differences may indicate vital factors in the learning process and may contribute to substantive theories (Baghaei & Carstensen, 2013).

Additionally, if a model with two or more latent classes provides a better fit than a model with only one latent class, the measurement invariance assumption is violated and a single Rasch model is not a fit. When there are more than one latent classes in the dataset, separate Rasch models with separate sets of item difficulties are required. These different item difficulties are considered latent sub-groups where they are not determined by covariates (Frick, Strobl, & Zeileis, 2015).

The Mixture Rasch Model

Mislevy and Verhelst (1990) and Rost (1990) used the dichotomous MRM as a first application of Mixture Item Response Theory (MixIRT) model to explore unobserved heterogeneity in a population by revealing different latent subgroups of individuals based on their observed response patterns. Dallas and Wilse (2014) used the Mixture Rasch Model to demonstrate all stages of model estimation and selection, description of model results, and follow-up analyses using real survey data. It was expected that the MRM would identify classes of individuals who have different response patterns on the survey. Mixture IRT models possess an advantage over IRT models in that they offer not only quantitative data but also qualitative data pertaining to both the items and the test-takers, in contrast to IRT models which only provide quantitative information (Sen & Toker, 2021). Following mathematical formulas used by Rost (1990) to explain the proposed model.

If ρ_{vig} indicates person v answering "yes" or correctly answering item i and this person belongs to latent class g then one can say that subjects' response probabilities can be shown by the dichotomous Rasch model

$$p_{vig} = \frac{\exp(\tau_{vg} + \sigma_{ig})}{[1 + \exp(\tau_{vg} + \sigma_{ig})]},\tag{1}$$

where τ_{vg} is the participant's ability and σ_{ig} is the item easiness parameter. Within each latent class g an indeterminancy constraint $\sum_i \sigma_{ig} = 0$ must hold. Furthermore, if the researcher thinks latent classes are mutually exclusive and exhaustive, structure of the latent class is as follows:

$$p_{vi} = \sum_{g} \pi_{g} p_{vig}$$

$$\sum_{g} \pi_{g} \frac{\exp(\tau_{vg} + \sigma_{ig})}{[1 + \exp(\tau_{vg} + \sigma_{ig})]}$$
(2)

where p_{vi} is the unconditional response probability and π_g is the class size parameter or "mixing proportion with constraints between 0 and 1 and $\sum_g \pi_g = 1$.

To define the entire model since simpler models do not explain and specify how to deal with the person parameter, τ_{vg} , it is crucial to control the person parameters using a Rasch-like model structure. To get the likelihood function, it is also important to get the pattern of probabilities p(x) which is $x = (x_1, x_2, \dots, x_i, \dots, x_k)$ where $x_i = 0$ or 1. So the formula for the pattern probability can be:

$$p(\mathbf{x}) = \sum_{\mathbf{g}} \pi_{\mathbf{g}} p(\mathbf{x} \mid \mathbf{g})$$
(3)

where $p(\mathbf{x} | \mathbf{g})$ is the product of response probabilities defined by Equation 1 over all items. In the Rasch model the number of correct item responses is used to estimate τ . So, all persons with the same score *r* have the same τ score. As a result of this, the pattern probability $p(\mathbf{x} | \mathbf{g})$ can be rewritten with the score *r* associated with a given pattern as follows

$$p(\mathbf{x} \mid \mathbf{g}) = p(\mathbf{x} \mid \mathbf{g}, \mathbf{r}) \bullet p(\mid \mathbf{g}).$$
(4)

This factorization is quite important and useful since only the first factor depends on the item parameters σ_{ig} ,

$$p(\mathbf{x} | \mathbf{g}, \mathbf{r}) = \exp(\sum_{i} x_{i} \sigma_{ig}) / \Phi_{\mathbf{r}} [\exp(\sigma)].$$
(5)

In this formula, Φ values are the symmetric functions of order *r* of the delogarithmized item parameter values. Moreover, only the second factor depends on the ability distribution in class *g*. The MRM is also a "distribution free" model just like the simple Rasch model.

A combination of all these elements defines the likelihood function of the model as follows;

$$L = \coprod_{x} \{ \sum_{g} \pi_{g} \pi_{rg} \exp(\sum_{i} x \, \mathrm{i}\sigma_{ig}) / \Phi r \, [\exp(\sigma)] \}^{\mathrm{n}(x)} , \qquad (6)$$

where n(x) denotes the observed number of response patterns x, and the score probabilities $\pi_{rg} = p(r | g)$ have been rewritten by using Greek letters for renaming the model parameters.

Using the model formulas, the number of independent model parameters is constructed as follows:

h - 1 class size parameters π_a , where *h* is the number of classes,

(k - 1) h class-specific item parameters, where k is the number of items measured and must be lowered by 1 because of the norming constraint, and

2 + h (k - 2) class-specific score probabilities, because one parameter in each class depends on the sample size and the class size, and the two parameters for the 0 and 1 vectors are class independent

As it can be seen from Equation 1, the Rasch model is a one-class solution of the proposed model. Additionally, the same Equation is a special case of a simple latent class analysis.

Professional Preparation Survey

Research has shown that teachers play a critical role in enhancing student achievement (Goe, 2007; Hanushek & Rivkin, 2010; National Research Council, 2010). This finding has been made possible through better assessments, P-12 standards, data systems, and statistical analyses such as growth and value-added modeling. It has been established that effective teachers improve student achievement, while ineffective teachers negatively impact students, sometimes for several years (Sanders & Horn, 1998; Sanders & Rivers, 1996). This result has propelled research and policy towards the next step: how do we ensure that all teachers are effective, and how do we support them in developing the "sophisticated expertise" (Darling-Hammond & Bransford, 2005, p. 3) that characterizes outstanding teaching?

A grant supported by the Institute for Education Sciences (Award #R305A120233) supported development of assessments of preparation of teachers. As one of the early steps in this study, surveys were created to assess perceptions of preparation from the perspectives of teacher candidates, recent graduates of teacher preparation programs, and faculty members who taught in the teacher preparation programs. The purpose of this paper was to examine whether responses to items reflecting perceptions of preparation yielded different item positions across groups of survey respondents and so led to the existence of distinct latent classes. The existence of latent classes suggest that the variable takes a different definition for different groups of respondents.

This grant began with the creation of Core Competencies (CCs) or competencies considered essential for effective teaching. The survey examined here is based on the final CC's. To identify Core Competencies (CCs), documents regarding national teacher standards were examined. These included: The Interstate Teacher Assessment and Support Consortium (InTASC), The National Council for Accreditation of Teacher Education (NCATE), which is now CAEP, The National Board for Professional Teaching Standards (NBPTS), The Teacher Education Accreditation Council (TEAC), and the exam elements of the Praxis II, which is a national teacher certification test. In all, 16 sources were analyzed and represented in a matrix of the content of teacher preparation selected on the dual justification that:

1) Policy licensure and accreditation restrictions are calling for these CCs in order to teach; and

2) Programs are required to provide some evidence of how these CCs are incorporated into their program to achieve accreditation/licensure approval.

This initial mapping identified 12 potential CCs, each of which appeared in at least three of the 16 national or state sets of licensure/accreditation standards and policy recommendations. In order to focus the study, the initial 12 CCs were narrowed based on existing research and whether the CC is likely to be taught in the program (rather than being a selection criterion), is variable among programs, is observable, and is regularly employed in schools. The 12 potential CCs were grouped into 8 CCs that were considered to have less overlap, with vignettes written for each with 5-6 descriptors that would form the basis for survey items. These eight areas became: demonstrating mastery of and pedagogical expertise in content taught; managing the classroom environment; developing a safe, inclusive, respectful environment for a diverse population of students; planning and providing instruction; designing and adapting assessments, curriculum and instruction; engaging student in higher order thinking and professional growth. Details of these core competencies with descriptors can be found in Appendix A. No information was available on whether surveys would measure similar constructs for all groups. Briggs et al. (2013) analyzed data from two of the three surveys, and concluded that different approaches to examining dimensionality yielded different conclusions about program effects.

The present study examined the questionnaire validation to see if collected data yielded different sub-groups within the selected groups. The main goal of this study is to present a demonstration of usefulness of the Mixture Rasch Model for the analysis of survey data.

Method

Participants

Table 1 provides a comprehensive overview of the traits exhibited by the three groups of participants. However, it should be noted that not all variables were gathered from all participants, partly due to confidentiality concerns. The majority of respondents who were candidates or graduates were young, white females from a conventional teacher education program. Most of the faculty members who responded had full-time involvement with the program. The survey garnered responses from 296 candidates, 648 graduates, and 501 program faculty. These faculty members were drawn from teacher preparation university faculty and field supervisor teaching faculty responsible for overseeing clinical teaching preparation experiences.

Table 1

Gender of TIMSS-2011 Subjects (based on booklet selection)

	Gender						
Group	Female		Male	Male			
	Selected	%	Selected	%			
Teacher Candidates	49.40	49	50.60	51			
Program Graduates	49.10	49	50.90	51			
Program Personnel	50.30	48	49.70	52			

Note: Gender is shown in percentages.

Measure

The survey, as described above, was created via literature review and a comprehensive analysis of sources of standards for teacher preparation, to define eight competency areas (Hartnett-Edwards, Seidel, Whitcomb, Spurlin, Anderson, Green, & Briggs, 2013) with one additional area suggested by an advisory panel. Items were written by project personnel and vetted through teacher education program directors and a regional advisory panel. After modifications based on a series of cognitive interviews, the survey was approved by a panel of deans of colleges of education in the state. Figure 1 provides an example of a partial survey page from one of the three surveys. Further detail about the survey development and sample surveys can be found at the study's online site, www.portfolio.du.edu/IES.

and Professional Growth

two statements about work that teachers do, which may have been addressed in your preparation program. r program experience, please rate how these were addressed in your program, and how prepared you feel ov at all), up to a "4" (very much):

		 How regularly / deeply was this addressed in your coursework / seminars (not teaching experiences) 			2. Explicitly addressed in student teaching experiences?		3. OVERALL, he do you feel to d regular te:				
		0 - Not	1	2	3	4-major focus	Yes	No	Not Sure	1- not at all	2
her uses multiple formal and in ts know and can do to analyz (der to evaluate and critically ing. S/he is aware of the stre asks.	nformal sources of evidence about e student learning, development, and reflect on the educational impact of ngths and weaknesses of his/her	0	0	0	0	0	0	0	0	0	C
her is aware of and critically r cultural identity as an individu her interactions and relationsh and community.	eflects on his/her own identity as a al, and works to reflect on and ips with students, other educators,	0	0	0	0	0	0	0	0	0	C
ng only your coursewor om the instructors in yo	<i>k and class-type sessions,</i> wha our program about the teacher	t was work	the des	MO	ST T ed in	TYPICAL h the 2 st	form of tatemen	feedba ts abov	c <mark>k that</mark> e?	you	us
	Evaluative feedback		[Descri	iptive	Feedback		Descri	ptive Fee	dback	c with

Istructors about the teacher work described in the 2 statements above?

Figure 1. Detail of a survey page.

The body of the survey for teacher candidates was split into nine sections, with each section eliciting views about an area of teaching competency. Each section contained three response scales oriented to appraisal of views about how extensively the content reflected in the item was covered in teacher preparation coursework-style experiences, how intensively it was addressed in teacher field-based experiences (e.g., student teaching placements), and perception of level of preparation overall. In total, the survey of teacher candidates contained 111 attitude items, 40 of which reflected overall satisfaction with the program. For additional de tails on these two surveys, see Briggs et al. (2013) or the study's site www.portfolio.du.edu/IES.

The survey of teacher education program faculty contained 51 items. One item asked about extent of involvement with the program and the remaining items asked "OVERALL, how well does the program prepare candidates to:" where the remainder of the statement was taken from the wording for the candidate and graduate surveys. Only the 40 items common to surveys of all three groups of respondents were used in the present study.

Procedure

The project staff generated the online surveys, consent forms, and email instructions to access the survey. This information was sent to directors of teacher preparation programs in the state. Directors of the teacher preparation programs sent a link to the survey via email to program teacher candidates with a request to complete the survey, as data were to be used for program evaluation and accountability purposes. In addition, project staff pulled publicly available district-school emails for 897 graduates which located recent programs' graduate placements in public school posts. Directors of teacher preparation programs were also sent a link to the personnel survey with a request to convey the survey to their faculty and to mentors and lead teachers associated with the program. The surveys were open from May 2012 through November 2012. Potential participants had approximately three months to respond. Qualtrics (Qualtrics.com) was used as the online survey site; when the survey was closed, data were downloaded as an Excel spreadsheet and transferred into a statistical software package. As the survey invitations were sent by individual program directors and not by the project staff, accurate response rate information is not available. However, response rates of surveys of program personnel ranged from approximately 20% to close to 100% for different programs.

Data Analysis

The responses were used to run the mixture Rasch model analysis using WINMIRA (von Davier, 2001a). Although, items had four levels, they were recoded into dichotomous responses due to WINMIRA not being able to handle the analysis. Since the data were sparse, competing models were selected by means of information criterion values which were the Pearson Chi-square value and Cressie-Read statistic (Cressie & Read, 1984). Information criteria used in this study were the Pearson Chi-square value and Cressie-Read where larger values show better fit (von Davier, 2001b). Once the latent classes were identified, item fit was examined.

Number of latent classes

To find the appropriate number of latent classes, competing models with one, two, three, and four latent classes were fit to the data for the survey. Table 2 shows p-values of the Pearson Chi-square and Cressie-Read for the four models. Table 2 suggests that there were two latent subgroups based on larger values of the Pearson Chi-square and Cressie-Read. Results showed that the mean of the raw scores of class 1 was high (M=31.88 SD=9.26), class 2 was medium (M=27.45, SD=11.10). It is crucially important to compare item parameters across different classes when deciding on number of classes.

Table 2

Â	U U	-
Model	<u>Cressie Read</u>	Pearson X ²
1-Class	0.00	0.00
2-Class	0.08	0.13
3-Class	0.00	0.17

The final dataset consisted of 40 items with 576 participants. To determine the appropriate number of classes, one, two and three class solutions were fit to the data (see Table 2). P-values for the dataset of Cressie-Read and Pearson Chi-square were .08 and .13. Since the two class model had the appropriate p-value, a two-class solution was selected. Class size values for each class shows that class 1 was expected to include about 72% of the sample. Class 2 was expected to include about 28% of the sample. According to the Q-index, there was no need to remove any items since all of the items fit each class well (.05) (See Table 3). To obtain additional information about the survey instrument or the IES grant project, readers can contact co-author Kent Seidel.

		Class -1		Class -2		
			р			р
Item	Q-index	Zq	(X>Zq)	Q-index	Zq	(X>Zq)
I1A	0.13	0.49	0.31	0.23	1.84	0.03
I1B	0.12	0.48	0.32	0.13	-0.43	0.67
I1C	0.12	0.19	0.42	0.11	-0.86	0.81
I1D	0.12	0.62	0.27	0.17	0.47	0.32
I1E	0.15	1.93	0.03	0.20	1.26	0.10
I2A	0.11	0.19	0.42	0.25	1.52	0.06
I2B	0.08	-0.49	0.69	0.23	1.65	0.05
I2C	0.07	-0.57	0.72	0.22	1.08	0.14
I2D	0.08	-0.40	0.66	0.13	-0.43	0.67
I2E	0.09	0.03	0.49	0.17	0.56	0.29
I3A	0.11	-0.06	0.52	0.12	-0.40	0.66
I3B	0.08	-0.50	0.69	0.11	-0.85	0.80
I3C	0.09	-0.21	0.59	0.13	-0.35	0.64
I3D	0.10	-0.04	0.52	0.17	0.37	0.35
I3E	0.11	0.63	0.26	0.17	0.65	0.26
I4A	0.09	-0.21	0.58	0.18	0.57	0.29
I4B	0.09	-0.23	0.59	0.15	-0.03	0.51
I4C	0.07	-0.67	0.75	0.06	-1.78	0.96
I4D	0.08	-0.41	0.66	0.14	-0.26	0.60
I4E	0.10	0.07	0.47	0.13	-0.32	0.63
I5A	0.09	-0.13	0.55	0.13	-0.07	0.53
I5B	0.07	-0.75	0.77	0.15	0.24	0.41
I5C	0.07	-0.77	0.78	0.09	-0.88	0.81

Table 3Item fit assessed by the Q-index for all classes

I5D	0.11	0.68	0.25	0.12	-0.29	0.61
I5E	0.07	-0.58	0.72	0.07	-1.59	0.94
I6A	0.13	0.20	0.42	0.06	-1.87	0.97
I6B	0.08	-0.52	0.70	0.11	-0.92	0.82
I6C	0.07	-0.56	0.71	0.11	-0.80	0.79
I6D	0.12	0.20	0.42	0.17	0.79	0.21
I6E	0.12	0.32	0.37	0.09	-1.10	0.86
I7A	0.09	-0.23	0.59	0.05	-1.85	0.97
I7B	0.12	0.86	0.19	0.19	1.10	0.14
I7C	0.09	-0.38	0.65	0.14	-0.30	0.62
I7D	0.10	-0.16	0.56	0.13	-0.21	0.58
I7E	0.10	-0.07	0.53	0.17	0.40	0.34
I8A	0.12	0.17	0.43	0.08	-1.46	0.93
I8B	0.14	0.57	0.28	0.16	0.08	0.47
I8C	0.15	0.84	0.20	0.16	0.25	0.40
I8D	0.08	-0.39	0.65	0.20	1.40	0.08
I8E	0.09	-0.33	0.63	0.29	2.06	0.02
I9A	0.13	0.49	0.31	0.23	1.84	0.03
I9B	0.12	0.48	0.32	0.13	-0.43	0.67
I9C	0.12	0.19	0.42	0.11	-0.86	0.81
I9D	0.12	0.62	0.27	0.17	0.47	0.32

Figure 2 shows that the two classes had different item difficulty parameters. Item difficulty estimates were different for the majority of items.



Figure 2. Class specific item parameter profiles

It can be concluded that all classes found the items to be relatively easy as logit position was generally negative (see Table 4 for specific values including standard error).

Table 4

faranciers of boomer one by classes							
Class	-1	Class	-2				
Estimate	Error	Estimate	Error				
-0.36	0.16	0.23	0.22				
0.14	0.15	0.20	0.22				
-0.49	0.17	-0.91	0.25				
0.32	0.15	0.23	0.22				
1.28	0.14	0.14	0.22				
-0.02	0.15	-1.34	0.27				
0.17	0.15	-0.51	0.23				
	Class Estimate -0.36 0.14 -0.49 0.32 1.28 -0.02 0.17	Class-1 Estimate Error -0.36 0.16 0.14 0.15 -0.49 0.17 0.32 0.15 1.28 0.14 -0.02 0.15 0.17 0.15	$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$				

I2C	0.09	0.15	-1.11	0.26
I2D	0.06	0.15	-0.68	0.24
I2E	0.74	0.14	-0.09	0.22
I3A	-0.94	0.19	-2.12	0.33
I3B	0.00	0.15	-0.53	0.24
I3C	-0.32	0.16	-1.13	0.26
I3D	-0.08	0.16	-0.91	0.25
I3E	1.28	0.14	0.76	0.21
I4A	-0.09	0.16	-0.50	0.23
I4B	0.35	0.15	-0.32	0.23
I4C	-0.32	0.16	-0.58	0.24
I4D	0.71	0.14	0.02	0.22
I4E	0.25	0.15	-0.09	0.22
I5A	0.91	0.14	0.92	0.21
I5B	1.07	0.14	0.56	0.21
I5C	0.82	0.14	0.97	0.21
I5D	1.01	0.14	0.88	0.21
I5E	-0.68	0.18	-0.60	0.24
I6A	-0.92	0.19	-0.57	0.24
I6B	-0.06	0.16	-0.19	0.22
I6C	0.05	0.15	-0.04	0.22
I6D	-0.04	0.16	0.01	0.22
I6E	-0.16	0.16	-0.05	0.22
I7A	0.61	0.14	0.56	0.21
I7B	1.03	0.14	0.47	0.21
I7C	-0.89	0.19	-0.63	0.24
I7D	0.08	0.15	0.19	0.22
I7E	-0.46	0.17	-0.86	0.25
I8A	-0.57	0.17	-0.41	0.23
I8B	-0.69	0.18	0.43	0.21
I8C	-0.61	0.17	0.50	0.21
I8D	-1.97	0.26	3.40	0.28
I8E	-1.26	0.21	3.71	0.30
I9A	-0.36	0.16	0.23	0.22
I9B	0.14	0.15	0.20	0.22
I9C	-0.49	0.17	-0.91	0.25
I9D	0.32	0.15	0.23	0.22

For example, item I1E had an item difficulty parameter of 1.87 and a standard error of 0.07 for class one and an item difficulty parameter of 0.13 and standard error of 0.08 for class two.

Conclusion and Discussion

The survey was created from an extensive literature review and content expert reviews of documents pertaining to teacher standards that guide teacher preparation programs. This yielded eight themes which we named "core competencies" that are essential for effective teaching. The survey was created based on these 8 CC's with 4-6 questions for each CC. The purpose of this study was to the questionnaire validation to see if collected data yielded different sub-groups within the selected groups. Founded response patterns shows that construct validity might be called into question. This means that the same construct is not being measured same for all participants. Differences in item logit positions per class suggest further investigation into survey validity.

Based on these analyses, teacher preparation programs and even professional development personnel need to evaluate their current programming to consider what aspects are Skills related and what is Resource Use related. This in no way means that we ignore the eight core competencies, but this adds a new way to understand the focus of teacher development programs.

Recommendations

Asking what skills a teacher needs and what aspects of their program teaches students how to use resources creatively and effectively could improve the program and may lead to more effective teachers. Further research can focus on testing the validity of the survey using different techniques. Since the original development data analyzed here (collected for the Institute of Education Sciences grant), the survey instrument has been modified and used over a period of time as a formative tool in several types of preparation programs. Candidates use the survey to guide their self-assessment, and their clinical experience coaches have used the survey to guide formative evaluation. Programs for this continued research and development have included two field-based alternative route programs; two "traditional-design" university programs; and two partnership professional development school model programs, in which experienced teachers in the school where candidates are placed for clinical experiences serve as co-instructors.

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Author (s) Contribution Rate

Authors contributed equally to the study.

Conflicts of Interest

There is no conflict of interest for individuals or institutions in this research.

Ethical Approval

Ethical approval for this study was obtained from Usak University Ethics Committee on 19.01.2023.

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Mediating Role of Academic Self-Efficacy Between Insufficient Self-Control and School Dropout

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Mediating Role of Academic Self-Efficacy between Insufficient Self-Control and School Dropout

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Abstract

School dropout is a devastating problem leading to negative consequences not only for individuals but also society. Therefore, numerous preventive measures and interventions have been implemented, but the expected outcomes have not been obtained despite vigorous efforts. This may indicate that the dropout process is complicated and not limited to academic issues. Therefore, dropout should be addressed using a more comprehensive approach that integrates personnel as well as cognitive structures like schemas. Here, the relationship between dropout and its possible predictors—insufficient self-control schema and academic self-efficacy—was investigated with 365 high school students. Mediation analysis was conducted via the PROCESS macro. Academic self-efficacy was found to fully mediate the relation between insufficient self-control and dropout, and the indirect effect was also found to be significant. The findings were discussed in the framework of the literature.

Keywords: School dropout, Insufficient self-control, Academic self-efficacy

Introduction

School has a significant role in individuals' developmental processes. Schools not only enable individuals to be literate and learn arithmetic skills but also give them opportunities to participate in various social and cultural activities (Mahoney & Cairns, 1997). Thus, schools may be centers at which students acquire basic life skills and become prepared for life multidimensionally. Therefore, it is extremely important to ensure that all students have access to qualified education (Rumberger, 1987). Schooling can facilitate the academic and psychosocial developmental needs of individuals such as belongingness and socialization. Thus, it is possible to say that schooling results in healthy and productive individuals. Thus, various intervention programs and projects have been conducted to prevent school dropout (Prevatt & Kelly, 2003). Despite these programs and projects enabling all children to have an access to qualified education (Rumberger, 1987), many adolescents do not start either high school at all or drop out without completing high school education (Vallerand et al., 1997; White & Kelly, 2010). School dropout is thus a serious problem.

School dropout is defined as a process that emerges with disliking school as well as alienation and disengagement from school due to absenteeism, academic indifference, or failure (Christenson & Thurlow, 2004). It ends with leaving the education system without receiving a high school diploma (Alexander et al., 1997). Dropouts have some typical and common characteristics, and thus possible dropouts could be predicted by their primary school experiences. Dropouts experienced more absenteeism and academic failure compared to graduates, and this difference became increasingly evident from the fifth grade to high school. Moreover, the possibility of dropout among ninth grade students could be predicted with 85% accuracy when they failed three or more courses (Barrington & Hendricks, 1989). Thus, academic failure is one of the most significant indicators of dropout (Barrington & Hendricks, 1989; Rumberger, 2001). It is intensified by low academic self-efficacy (Lane et al., 2004). Academic self-efficacy is a significant predictor of school dropout.

Academic self-efficacy is defined as an individuals' beliefs in their capacities to fulfill academic task demands and achieve specific results (Bassi et al., 2007). It includes individuals' self-evaluation about how efficient they perceive themselves with regard to fulfilling tasks specific to a certain academic field (Dorman, 2001). When people have difficulties in reaching their academic goals, their academic self-efficacy belief determines how much

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effort they will spend, how long they will continue to strive, and their motivational levels (Bandura, 2001; Kassab et al., 2015). For example, individuals with a high level of academic self-efficacy are more likely to be motivated to cope with school-related difficulties and eventually be successful (Balkıs, 2011; Honicke & Broadbent, 2016). Thus, such a student's probability of choosing maladaptive behaviors like dropout decreases (Schunk & Pajares, 2002).

Academic self-efficacy is closely related with self-control (Bandura, 2001). Students who think that their academic success is under their control feel themselves efficacious in the face of academic difficulties; thus, their perceived level of control results in effort, persistence, and eventually achievement despite difficulties (Honicke & Broadbent, 2016). Thus, self-control is a self-efficacy determinant that can be stated as a protective factor against school dropout (Schunk & Pajares, 2002).

The relationship between self-control and dropout is shown in Strain Theory. According to Strain Theory, the failure to achieve academic goals or frustration at school leads to stress and eventually adaptation problems like delinquency. When children feel themselves under pressure due to the inability to fulfill requirements of academic life resulting from insufficient self-control, they react with either leaving school suddenly or exhibiting delinquent and aggressive behaviors (Agnew, 1992; Jarjoura, 1993) because self-control enables individuals to resist to the temptation to exhibit behaviors that are satisfying in the short-term but costly in the long run (Schweitzer & Sulzer-Azaroff, 1988).

Success in school requires delaying more entertaining activities such as friends and browsing social media because one must do homework and study to become successful. Thus, the desire for academic success can lead to conflicts in terms of balancing priorities. The level of self-control can determine how this conflict is resolved which alternatives are preferred (Duckworth et al., 2019). Self-control is acquired progressively after completing certain stages in developmental process as a result of an internalization of other directedness instructions (Flammer, 1995). Initially, the responsibility for personal regulation is left to adults especially primary care-takers (Duckworth et al., 2019). That is, external control or other-directedness instruction is needed before self-control is acquired. In other words, children can control themselves only through external instructions in early stages of development.

At the next stage, children try to control themselves by repeating instructions that were previously given by others aloud. Finally, children control themselves through internalization of self-talk or their thoughts (Meichenbaum & Goodman, 1971). It can be stated that evolving of verbal self-instructions to the cognition in the form of schemas is an initial critical point in self-control development. This developmental process from self-talk to real selfcontrol indicates the transformation of external control to internal control through cognitive constructs like schemas (Meichenbaum & Goodman, 1969). Since schemas provide the general framework for organizing and interpreting stimuli, self-talk and schemas are the main determiners of behaviors and reactions of individuals. Both self-talk and schemas are constructed on initial experiences and socialization processes of individuals (Bandura & Walters, 1963); thus, insufficient self-control schema also starts to be built up on the basis of parent's instructions and rules. Children construct their self-control schema by parent's instructions and feedback, and then elaborate with each new experience with friends and other social agents like schools (Flammer, 1995). Schemas are based on previous experiences and also project future possible behaviors. Therefore, self-control as a form of schema sets the preconceptions of individuals' self-control capabilities, renders predictability, and fosters the development of self-efficacy. Both self-control and academic self-efficacy make perseverance possible when difficulties and frustrations are experienced (Honicke & Broadbent, 2016; Kassab et al., 2015); thus, these constructs play an important role in academic contexts that lead to responsibilities and limitations on students. Thus, insufficient self-control schema predict both academic self-efficacy and dropout; thus, our goal was here to investigate the relationship patterns among these three variables.

Insufficient Self-Control and Dropout

Academic success entails the regulation and control of individuals' thoughts, emotions, and behaviors to engage in the academic activities that students find tedious. Thanks to self-control, individuals can pursue the courses of actions that are necessary for reaching their long-term outcomes instead of more pleasing activities that results in immediate gratification (Musci et al., 2021). Thus, individuals with an insufficient self-control schema are more likely to drop out school (Moffitt et al., 2011; Vitaro et al., 1999). Insufficient self-control is related to academic failure, problems in peer relations, and other behavioral problems at school like aggression (de Ridder et al., 2012; Jimerson et al., 2000). This can consequently lead to dropout (Alexander et al., 1997; Moffitt et al., 2011; Vitaro et al., 1999). According to Dynamic Developmental Model, individuals start school with their innate characteristics, unique past experiences and attitudes, and the schemas formed in their first years of life (Jimerson et al., 2000). Therefore, this study addressed the role of insufficient self-control schema on dropout process. Insufficient self-control schema within the impaired limits schema domain is related to setting the boundaries, organizing oneself, regulating emotions, etc.

Schemas are the principles and rules individuals develop about themselves and the world as a result of an interactions with the environment and are formed from childhood (Young et al., 2003). These cognitive constructs include pervasive patterns comprising not only individuals' thoughts but also their memories, emotions, and bodily sensations of themselves and relationships with others (Rafaeli et al., 2010, p.13). If individuals' basic needs such as setting realistic limits (self-control) are not fulfilled in their relationships with primary care taker and environment, then they form dysfunctional schemas that are detailed and strengthened with each experience and maintained long-term. These cognitive patterns including insufficient self-control schema contain generalizations that are independent of circumstances (Oei & Baranoff, 2007); thus, insufficient self-control schema as a product of core schemas related to the self-concept is transferred to different areas of life (Hagger et al., 2010). The result is that individuals perceive that they do not have control over their emotions, thoughts, and behaviors (Huntjens et al., 2014). Individuals with this schema have difficulty in limiting themselves, setting realistic goals, and maintaining the effort to attain their goals (Rafaeli et al., 2010; Welburn et al., 2002).

An insufficient self-control schema causes individuals to have trouble in tolerating frustration because it leads individuals to find controlling themselves unnecessary and hence results in increased tendency to express their emotions and impulses in an exaggerated way rather than suppress these impulses if required. Thus, individuals who cannot control themselves avoid conflict and confrontation at all costs and refrain from taking responsibility at the expense of not achieving desires and developing personal integrity (Young et al., 2003). Therefore, these individuals prefer the easiest way of making no effort rather than coping with difficulties and bearing with patience to reach their long-term goals (Rafaeli et al., 2010). In contrast, academic success requires setting goals, making plans, and having effective time-management to attend and engage in learning activities (Meece & Eccles, 2010). Managing learning processes that bring success at school, comprise a set of skills requiring self-control. Individuals who can control themselves play an active role in managing their own learning processes by displaying skills such as monitoring and organizing oneself at metacognitive level and exhibiting behaviors such as regulating oneself, paying attention, and structuring learning environments (Zimmerman, 2013). They use the strategies appropriate for their learning style, make plans to correct deficiencies, and take responsibility for academic development while learning subject matter (Schraw, 1998). As a result, the possibilities of being satisfied with school life and being engaged in school increase as well (Schunk & Mullen, 2012). Accordingly, when the individuals cannot control themselves start school, they have difficulty in completing school tasks, and teachers perceive them as uninterested students. Consequently, these students have higher probability of experiencing various adaptation problems such as academic failure and absenteeism. In turn, they get disconnected with school and eventually face dropout (Rumberger & Lim, 2008).

Insufficient Self-Control and Academic Self-efficacy

The formation of academic self-efficacy belief first begins in infancy. It is based on the family feedback on an individual's competencies and continues to be shaped by the feedback received from teachers and peers in the following years. Individuals take others' feedback into account, and they build cognitive scenarios related to their self-efficacy based on these feedbacks. Therefore, parents who do not set limits for their children often have no expectations for them and do not support them to set goals from early ages. These children thus think that limiting themselves is unnecessary. These parents prevent their children from setting goals, motivating themselves, and feeling efficacious. Individuals who do not gain autonomy are devoid of the experiences by which they can test their ability to control themselves so that they sustain insufficient self-control in a vicious circle (Rumberger & Lim, 2008). As a result, these scenarios shape individuals and determine their performances (Bandura, 1993). For example, it is more likely that individuals form success-oriented scenarios if their efficiencies are emphasized and valued by others while individuals build failure scenario if their skills are ignored and under-valued.

According to Bandura et al. (1996), academic self-efficacy is based on an individuals' own academic experiences or mastery expectations; their own and others' attributions to their achievements or verbal persuasion; and vicarious learning process (Bandura et al., 1996; Schunk, 1991). Individuals with an insufficient self-control schema are more likely to receive regular negative feedback about their academic competencies from their parents, teachers, and peers. They then develop low academic self-efficacy beliefs and perpetuate their beliefs via verbal persuasion (Bandura et al., 1996; Schunk, 1991). Therefore, academic self-efficacy is not shaped by the grades

obtained from the courses but the evaluations and attributions to the individuals' abilities (Bandura et al., 1996; Pajares, 1996; Schunk, 1991).

Since insufficient self-control schema impedes self-efficacy and increases the likelihood of experiencing learned helplessness and feelings of ineffectiveness, individuals do not trust themselves to do a task assigned to them (Rocchino et al., 2017) often perceive academic tasks as difficult and expect low success (Pajares, 1996). In turn, they choose negative coping strategies like avoidance (Rocchino et al., 2017). They further focus on negative results when asked to do an academic task (Bandura, 1993). They do not feel motivated enough to act (Bandura et al., 1996). Mastery expectations are the most important source of achievement, and these minimize academic experiences and undermine individuals' self-efficacy levels. Insufficient self-control schema may lead to maintenance and confirming negative self-efficacy beliefs by not fulfilling school requirements such as doing homework and following rules. Another possibility is the avoidance of the situation requiring self-control when the schema is activated so individuals rob themselves of an opportunity to control themselves and reach positive outcomes; eventually, these people fail to acquire self-efficacy (Dozois et al., 2009).

Students with an insufficient self-control schema think that they do not have control over their learning processes. They cannot manage their school-related tasks and feel academically inefficacious (Schraw, 1998). In addition, they try to make a decision about their self-efficacy levels by observing their similar peers instead of direct experiences. Thus, they predict that they will also have difficulties in self-control process and fail academically just like their peers. Finally, their academic self-efficacy is not probably supported via vicarious learning process (Schunk, 1991). In conclusion, self-control lays the foundations of academic self-efficacy regardless of the sources. Self-control in early childhood was found to be a precursor of academic self-efficacy even after 11 years (Musci et al., 2021). Insufficient self-control predicts academic self-efficacy.

Academic Self-Efficacy and Dropout

Individuals primarily develop academic aspirations depending on their academic self-efficacy and then set goals and make plans to reach these goals (Bandura, 1993). Thus, academic self-efficacy is positively related to academic engagement (Bassi et al., 2007; Zimmerman et al., 1992), attending school (Zajacova et al., 2005), and focusing on the benefits of school such as providing a good future (Bassi et al., 2007). Students with low levels of academic self-efficacy spent more time in relaxing activities such as sleeping, having a rest, and taking care of their physical appearance. They spend less time doing homework (Caprara et al., 2008). Research has indicated that low academic self-efficacy is a significant predictor of dropout and can mediate the relation between school performance and dropout (Alivernini & Lucidi, 2011) as well as academic procrastination and academic achievement (Balkıs, 2011). Not giving up goals and persevering in the face of difficulties and frustrations like academic failure are ensured through individuals' persistent and stable self-schemas that are not easily affected by daily experiences (Jimerson et al., 2000). In summary, individuals' perceptions of their competencies and whether they can control themselves affect school performance through their psychological investment on academic processes and cognitive efforts (Kassab et al., 2015); thus, school engagement decreases with rising chance of dropout (Schunk & Mullen, 2012).

The Present Study

According to Social Cognitive Theory, individuals' academic self-efficacy expectations are shaped according to their first-hand experiences in an academic environment (personal accomplishments), the feedback they receive from observers (social persuasion), and vicarious experiences (through observation of others' performances); thus, an insufficient self-control schema increases the possibility of making negative evaluations about self-efficacy. People with this schema are not expected to be successful and improve their low self-efficacy as a result of the inability to control or delay their desires and impulses. They do not make an effort to achieve their goals. Individuals' academic self-efficacy decreases after they receive negative feedback as a result of their failures. At the same time, they observe their peers with insufficient self-control who withdraw and become unsuccessful due to intolerance to frustration and a failure in delayed gratification. This suggests that they lack the capacity to control their behaviors (Bandura, 1997). Since academic self-efficacy develops as a product of early schemas and is also related with dropout, it was intended to investigate the mediating role of academic self-efficacy between insufficient self-control schema and school dropout.

Method

Participants

Participants were students attending high schools at a mid-sized city. After obtaining informed consent and parental permission, data was collected from 436 voluntary high school students, but data of 57 participants were omitted due to missing items; 14 participants were also removed according to the Mahalanobis distance criterion for multivariate normality. Therefore, there were 365 high school students—118 (32.33%) of whom were females and 247 (67.67%) of whom were males. Five participants did not report their grades, 69 were freshmen, 95 were sophomores, 82 were juniors, and 114 were seniors. Ages ranged between 14 and 19. The mean age was 16.45 and the median was 17.

Instruments

School Dropout Factor of Risk Behaviors Scale

The school dropout factor of Risk Behaviors Scale developed by Gençtanırım-Kuru (2010) was used to determine school dropout tendencies of participants. The scale consists of six factors including 36 items for measuring risky behaviors. Factor loadings of a seven-item school dropout dimension changed between .57 and .76. Scores obtained from the subscale changed between 7 and 35. Higher scores implied a higher school dropout risk. Internal consistency coefficients for the scale and dropout factor were .91 and .83 in the first sample. Data analysis with another sample in the same study indicated that Cronbach alphas for the scale and dropout factor were .90 and .73, respectively. Test-retest analysis with a-two-week interval indicated the coefficient of .85 for the scale and .68 for dropout factor (Gençtanırım-Kuru, 2010). Internal consistency coefficients for school dropout was .74 (Çetin, 2019) and as .73 (Özer et al., 2011) in other studies. Here, the internal consistency coefficient for school dropout was .84.

Insufficient Self Control Schema of Young Schema Questionnaire-Short Form (YSQ-S3)

Participants' perception of their self-control level was determined through insufficient self-control schema of YSQ-S3. Young (1991 as cited in Young, 1999) obtained 16 schemas under the six schema domains. The next revision study indicated 18 schemas clustered under five general schemas (Young, 1999). Insufficient self-control schema under the schema domain of Impaired Limits was utilized in this study. We used YSQ-S3, which is a sixpoint Likert type instrument containing 205 items. Validity and reliability studies were conducted with both clinical and non-clinical samples (Schmidt et al., 1995; Young, 1999) and similar schemas and schema domains were obtained. An insufficient self-control schema was found as a common factor in both clinical and non-clinical samples. The scores obtained from a five-item insufficient self-control schema change between five and thirty. This schema's internal consistency and test-retest reliability coefficients were found as .92 and .66, respectively (Schmidt et al., 1995). These values indicated that YSQ-S3 was reliable and valid. An adaptation study was conducted by Karaosmanoğlu et al. (2005) and insufficient self-control schema was found to have an internal consistency coefficient of .75. For the adolescent population, the YSQ-S3 was adapted by Sarıtaş (2007) with a factor loading of insufficient self-control schema under the Impaired Limits-Exaggerated Standards of .50. Cronbach's alpha coefficient for insufficient self-control was .51. The internal consistency coefficient was .49 in this study.

Academic Self-Efficacy Factor of Self-Efficacy Questionnaire

Data of academic self-efficacy was gathered by academic self-efficacy factor of Self-Efficacy Questionnaire in Youths developed by Muris (2001) and adapted by Çelikkaleli et al. (2006). The scale consists of 23 items under the social, emotional, and academic self-efficacy factors. This is a-five-point Likert scale, and the points obtained from the scale range from 23 to 115. Higher scores imply higher levels of self-efficacy. The academic self-efficacy factor included eight items. The internal consistency was .64., and the test-retest coefficient was .77 (Çelikkaleli et al., 2006). In another study, the internal consistency coefficient was .80 (Çelikkaleli & Gündüz, 2010). In this study, the internal consistency coefficient was .76.

Procedure

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First, permissions for the use of all the scales in this study were received from the authors. Ethical approval was obtained from Research and Publication Ethics Committee of the University where researchers worked. We certified that the study was conducted according to ethical standards of Declaration of Helsinki. Participants answered a twenty-item booklet, and items were not expected to harm or cause discomfort not greater than their ordinary daily life. Despite this minimal risk, voluntary participants were provided a chance of withdrawing from survey at any time. In this framework, data were collected after taking informed consent and parental permission. School principals and the teachers at the school were informed about research process and permission for data collection process was obtained at first. Prospective participants were given an informed consent form and a parental permission form including detailed information about research process and ethical principles for parents' approval. One week later, researchers again went to the school and collected data from the students who were given parental permission and agreed to participate in this study. Participants were asked to answer self-reported instruments and three demographic questions (gender, age, grade level) during class hours.

Data Analysis

For analysis, initially preliminary analyses such as descriptive statistics, skewness, kurtosis values for normality, VIF and tolerance values for checking multicollinearity problem were examined. Then, regression-based bootstrapping analysis was used to examine if academic self-efficacy mediated the relationship between insufficient self-control and dropout.

Results

Our goal was to investigate the mediating role of academic self-efficacy between insufficient self-control and dropout of high school students. Descriptive statistics were examined before analysis (Table 1). Assumptions of regression analysis were checked. First, the data was normally distributed when all scales were examined via graphics. Then, skewness and kurtosis values were taken into account, and values between +2.58 and -2.58 at .05 significance level indicated normality of data (Weinberg & Abramowitz, 2002, s. 79). Initial correlation coefficients between the variables were computed for regression assumptions.

Table 1. Descriptive statistics and correlation coefficients								
Variables	1	2	Min	Max	М	SD	Skewness	Kurtosis
Insufficient self- control	-	-	5	30	16.49	4.51	.23	37
Academic self- efficacy	36**	-	8	38	25.01	5.38	23	10
School dropout	.18**	31**	7	27	11.62	4.30	.79	.55
N-365 ** p < 01								

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N=365, **p<.01

As seen in Table 1, all the relationships between the variables of the study were found to be significant at .01 level. Dropout tendency increased with worse self-control. In contrast, academic self-efficacy levels decreased as insufficient self-control levels increased. Dropout levels increased as the academic self-efficacy levels decreased. When correlation coefficients were evaluated according to Cohen's effect sizes, the relationship between insufficient self-control and dropout was low. The relationships between insufficient self-control and academic self-efficacy relative to academic self-efficacy and dropout were moderate (Cohen, 2013). These correlation coefficients implied that the predictive relationship between variables could be examined.

Tolerance and VIF values were examined to check the multicollinearity problem. The tolerance values were higher than .20 (Menard, 1995), and the VIF values were lower than two (Myers, 1990); thus, we concluded that there is no multicollinearity problem. A scatter diagram of the relationship between standardized residuals and standardized predicted values was also examined, and residuals were scattered randomly (Field, 2009); thus, we concluded that the assumption of the homogeneity of variance was also met.

Regression-based bootstrapping analysis was used to examine if academic self-efficacy mediated the relationship between insufficient self-control and dropout. Mediation analysis was conducted via PROCESS macro v3.3 developed for SPSS by Hayes (2019). Model 4 template was used in analysis, and the significance of direct and indirect effects was tested by utilizing bias-corrected 95% bootstrap confidence intervals, and the interval not including zero implied a significant value (Hayes, 2013).

As seen in Table 2, insufficient self-control predicted dropout directly, and total effect of insufficient self-control on dropout was found to be significant (B=.17, SE=.0492, t=3.389, p<.001, 95% CI [.07, .26]). Standardized regression coefficient of insufficient self-control on dropout was .18 ($\beta=.18$, p<.001, see Figure 1). The results explained 3% of the variance in dropout unless academic self-efficacy was controlled (R^2 Y,X= .03, F(1, 363)=11.49, p<.001). Moreover, insufficient self-control was found to predict academic self-efficacy significantly (B(a)=-.43, SE=.0584, t=-7.4065, p<.001, 95% CI [..55, ..32]). The confidence interval for regression coefficient of -.36 did not include zero ($\beta=-.36$, p<.001, see Figure 1), so this standardized regression coefficient was significant. This explained 13% of the variance in a mediator of academic self-efficacy as seen in Table 2 (R^2M , X=.13, F(1, 363)=54.86, p<.001).

Table 2. Regression results for the mediation effect of academic self-efficacy between insufficient self-control and school dropout

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Model	Estimate	SE	CI (lower)	CI (upper)	
Model without mediator					
Intercept	8.8642	.8418	7.2088	10.5197	
ISC \rightarrow SD (c)	.1669	.0492	.0700	.2637	
(Total Effect)					
Model with mediator					
Intercept	16.2357	1.5931	13.1028	19.3685	
ISC \rightarrow ASE (a)	4324	.0584	5472	3176	
ASE \rightarrow SD (b)	2294	.0427	3133	1455	
ISC \rightarrow SD (c')	.0677	.0509	0324	.1678	
$ISC \rightarrow ASE \rightarrow SD$.0992	.0248	.0550	.1520	
Indirect Effect (axb)					

Note. ISC (Insufficient Self-Control), ASE (Academic Self-Efficacy), SD (School Dropout) Predicting Academic Self-Efficacy (Path a) $R^2_{M,X}$ =.13, F(1, 363)=54.86, p<.001 Predicting School Dropout $R^2_{Y,X}$ =.03, F(1, 363)=11.49, p<.001 Predicting School Dropout $R^2_{Y,MX}$ =.10 F(2, 362)= 20.64, p<.001, Cohen's f^2 =.01

Next, academic self-efficacy was put into regression model together with insufficient self-control, and we concluded that academic self-efficacy predicted dropout negatively (B(b)=-.23, SE=.0427, t=-5.3764, p<.001, 95% CI [-31,-.15]). The significant standardized regression coefficient was -.29 ($\beta=-.29$, p<.001, see Figure 1). In addition, the predictive power of insufficient self-control on dropout became non-significant (B=.07, SE=.0509, t=1.3299, p=.1844, 95% CI [-.03, .17]), and the standardized regression coefficient dropped to .07 ($\beta=.07$, p=.1844) when academic self-efficacy was controlled.



Note. Standardized Beta Coefficient Path, *p<.001

Figure 1. Mediation effect of academic self-efficacy between insufficient self-control and school dropout

These findings collectively indicated that academic self-efficacy fully mediated the relationship between insufficient self-control and dropout. To get an unbiased estimator of the mediating role of academic self-efficacy, bootstrapping analysis based on 10,000 rounds of data resampling with 95% confidence intervals was conducted.

Bias-corrected bootstrap results and confidence intervals not including zero (see Table 2) indicated that the indirect effect through academic self-efficacy was significant (B(a*b)=.10, SE=.0240, 95% CI [.06, .15]). That is, academic self-efficacy decreased as the level of insufficient self-control increased; the decrease in academic self-efficacy led to the rise in dropout levels. Insufficient self-control and academic self-efficacy collectively explained 10% of the variance in dropout ($\beta=.10$, p<.0001); 59% of the total effect of insufficient self-control on dropout was explained by academic self-efficacy (Preacher & Kelley, 2011).

Discussion

This study investigated the role of insufficient self-control and academic self-efficacy on dropout to contribute to the literature by providing additional information about the dropout risk of high school students. This study found that insufficient self-control led to dropout through academic self-efficacy. The students who left school stated some reasons for dropout such as long-term absenteeism, failure in school (Berktold et al., 1998; Bridgeland et al., 2006), and inability to cope with the academic demands (Rotermund, 2007). Dropout suggestions about preventing dropout included more rules and less freedom in school and more control by their families. These suggestions may be evaluated as indicators of their insufficient self-control (Bridgeland et al., 2006). These findings suggest that dropouts lack self-control, which makes following rules and taking responsibilities in school possible.

One of the most significant reasons of dropout is academic achievement status (Schunk & Mullen, 2012). Although academic success has cognitive determinants such as academic efficacy and cognitive capacity, psychosocial factors also affect achievement (Kassab et al., 2015; Teo et al., 1996). Some psychosocial factors such as impulse control problem and behavioral disorders as well as insufficient social skills and gang membership are predictors of academic failure and dropout (Cairns et al., 1989; Pittman, 1991). These findings are supported by the studies revealing that academic failure and behavioral disorders are indicators of dropout but not the main causes of it (Jimerson et al., 2000; Özer et al., 2011). These findings suggest that not only dropout but also predictors of dropout such as behavioral disorders and academic failure are based on the self-control schema.

The self-control schema is a persistent and long-lasting construct related to organizing oneself. Thus, it has pervasive effects on academics and social life and is resistant to change. Thus, insufficient self-control schema leads individuals to use dysfunctional coping strategies when they are faced with the situations that require them to control themselves (Young et al., 2003). Individuals not expected to control themselves react to frustration by acting out their negative feelings and impulses instead of limiting themselves. Alternatively, they avoid situations requiring them to control themselves. Since insufficient self-control schema like all the other schemas results in generalizations and provides a framework for all later experiences, school-related experiences may also be constructed according to this schema and perceived in a distorted way (Huntjens et al., 2014). Individuals with this schema think that they cannot control themselves in school, cannot bear frustration and even do not find it necessary to control their impulses and emotions so that they try to accommodate their academic perceptions, behaviors, and attitudes to this maladaptive schema and move towards a dropout process with their negative behaviors and attitudes to wards school. In other words, insufficient self-control schema may lead individuals to strengthen their self-perception in a way that they cannot also control themselves in an academic environment via a self-fulfilling prophecy. These explanations indicate that insufficient self-control schema predicts academic self-efficacy.

School may be a threatening environment for individuals with insufficient self-control schema because selfcontrol is a prerequisite for school adaptation and success (Finn, 1989). School schema probably trigger insufficient self-control schema, and individuals who think they cannot control themselves corroborate their low academic self-efficacy by avoiding tasks and responsibilities in school. Students who do not do homework, do not listen to lessons, and express anger via aggressiveness and/or antisocial behaviors against frustration due to lack of control often receive negative feedback about academic self-efficacy from their teachers and friends. This feedback may intensify their low academic self-efficacy (Linnenbrink & Pintrich, 2002; Schunk & Mullen, 2012).

An insufficient self-control schema is a construct that includes individuals' general and common evaluations about whether they can control themselves whereas academic self-efficacy includes their specific thoughts and perceptions of if they can achieve academic goals (Linnenbrink & Pintrich, 2002). In other words, a self-control schema is one component of academic self-efficacy and may be a building block of academic self-efficacy. Insufficient self-control determines academic performance and outcomes by setting the boundaries of academic self-efficacy. These explanations seem to account for how academic self-efficacy acts as a bridge between insufficient self-control and school dropout.
It may be stated that individuals' abilities to evaluate frustrations and difficulties at school as an opportunity not a threat for themselves depend on directly academic self-efficacy (Caprara et al., 2008) and indirectly self-control schema. Because The skills that motivate people to make an effort for being an active agent or having a sense of agency are symbolic processes and self-regulatory capacities that underlie academic self-efficacy. According to social cognitive theory, symbolic processes enable individuals to regulate and adapt to their environment through thinking via their cognitions at first and then reacting behaviorally. Symbolic processes allow planning and prediction before acting. This leads to regulation and continuity of behavior by providing scripts for situations and contexts. Symbolic processes refer to cognitive schemas in this framework. Therefore, an insufficient self-control schema plays an important role in the determination of academic self-efficacy acting as a symbolic process (Schunk & Mullen, 2012). Taking into account the fact that insufficient self-control schema leads individuals to think unwittingly that they cannot control themselves and then make them behave according to these thoughts, it becomes apparent how insufficient self-control predicts academic self-efficacy.

Although schemas provide a base for reactions and behaviors of individuals, they are expressed by informationprocessing procedures in cognitive system. Schemas set internal standards and goals, and information-processing procedures enable individuals to react consistently with these standards and goals (Schunk & Mullen, 2012). Based on this, it can be stated that insufficient self-control sets limits and standards of controlling oneself, and academic self-efficacy makes the achievement of these standards possible through information processing procedures. This explanation also sheds light on the finding that insufficient self-control predicts academic selfefficacy.

Academic self-efficacy including individuals' expectations of what they are capable of leads the learning process by affecting their goal-setting process, efforts, and persistence while trying to reach goals. This also impacts the way that they handle obstacles and eventually results in academic success or failure (Bandura, 1997). According to social cognitive theory, individuals do not react automatically but rather set a goal before taking an action. They then review and evaluate the strategies that they would use. If they make positive evaluations about strategies, then they take action. At the same time, they continuously review their behaviors and results of these behaviors and evaluate themselves to see if they need to reorganize their strategies and methods. Consequently, academic self-efficacy is related not only to the past but also to the future in terms of future goals and expectations (Schunk & Mullen, 2012). In this respect, academic self-efficacy functions as a mediator between the insufficient selfcontrol schema and the school dropout.

When the academic self-efficacy of individuals with equivalent cognitive abilities are enhanced, they set bigger goals, become more flexible in terms of strategy and methods, and assess their performances more realistically regardless of actual performance (Caprara et al., 2008). However, individuals with a low academic self-efficacy cannot evaluate their performances realistically and overestimate their efforts (Hagger et al., 2010; Hutchinson et al., 2008); they misperceive their tasks as more difficult. All of these explanations suggest that individuals with low academic self-efficacy act with the misperception that they cannot obtain the desired outcome despite the great effort. They attribute their academic failure to their inability ignoring their lack of effort, and they give up (Sylva, 1994). Since individuals with low academic self-efficacy think that they cannot change the outcome and cannot be successful despite their demand for success and efforts, they may find going to school unnecessary and exhibit various behavioral disorders such as absenteeism and truancy (Bridgeland et al., 2006). These adaptation problems may lead to academic and social disengagement from school, low school performance, and consequently dropout.

In this research, academic self-efficacy fully mediated the relation between insufficient self-control and dropout. This finding is consistent with the views and the findings in the literature indicating that individuals' all adaptive and maladaptive reactions are based on schemas. The schema-focused cognitive approach explaining the relations between individuals' early maladaptive schemas and maladaptive behaviors provides evidence for how mediation relation operates. Because the schemas developed based on previous experiences of individuals direct all of the reactions by interacting with the current situation and experiences (Young, 1999). Considering that insufficient self-control schema tries to confirm itself by negatively affecting individual's self-regulation capacity, it may be stated that this schema manipulates academic self-efficacy and sharpens the perception of insufficiency in school via academic failure, absenteeism, and discipline problems. This finally results in dropout.

In sum, individuals with insufficient self-control schema think that they cannot control themselves in academic life, cannot meet the expectations of school system, and cannot delay their gratification to be engaged in academic studies. In this framework, from the first time the students enter school, they may try to convince not only themselves but also their families and teachers that they cannot meet academic expectations; thus, they should not

have any expectation from themselves. Thus, they do not fulfill academic responsibilities and activities that ensure school engagement. They fail academically because they do not try. At the same time, they cannot follow the institutional principles and rules that enable social engagement with school, and consequently show maladaptive behaviors causing disciplinary problems and absenteeism (Rumberger & Larson, 1998). As a result, individuals' academic self-efficacy levels decrease directly and immediately afterwards. As academic self-efficacy levels decrease as well. They are unwilling to make necessary efforts and become disengaged from school. Individuals who do not feel belonging to school reduce expectations of their families primarily and their teachers over time and thus confirm their negative perceptions of themselves by receiving negative feedback from their families and teachers about their sufficiency. In this way, they confirm and verify insufficient self-control schema via dropout resulting from low academic self-efficacy.

Conclusions and Implications

This study investigated the sequential relation between academic self-efficacy and insufficient self-control, which were the potential predictors of school dropout that lead to negative consequences for not only individuals but also society. The results indicated that insufficient self-control predicted dropout through the agency of academic self-efficacy. This finding is important and reveals that dropout is a phenomenon that cannot be limited to only academic life, and that individuals' developmental processes, early life experiences, and cognitive constructs based on these experiences and psychological factors play an important role in explaining school dropout. In this context, indicating that the early maladaptive schemas also predict dropout makes an important contribution to the literature because most variables studied in the literature such as absenteeism, truancy, and academic failure are late indicators of dropout. These refer to the last phases of dropout process, and thus interventions to these problems are generally late and ineffective. They cannot refrain potential dropouts from leaving school without earning a diploma. In conclusion, identifying potential dropouts as early as possible is critical (Jimerson et al., 2000) for prevention because the schemas are consolidated and become increasingly rigid by each experience in the developmental process; thus, it is less likely to change schemas and reach effective results through these late interventions. Thus, it is critically important to implement interventions as the first indicators of dropout problem are observed. As possible indicators of insufficient self-control, adaptation problems during preschool period – e.g., impulse-control disorder, oppositional-defiant disorder and lack of self-regulation- may be regarded as primary signs of dropout, and these symptoms may provide opportunity for identification of at-risk individuals. Furthermore, carrying out prevention studies employing early intervention programs for at-risk individuals in terms of dropout can increase the effectiveness of the studies intending to decrease the psychological, social, and economic costs of dropout.

Although politicians and institutions such as ministries have crucial roles in preventing dropout, this study indicates the importance of immediate preventive measures taken at an individual level by counselors, teachers, families, etc. Implementing interventions for those considered to be at risk of dropout before symptoms become more severe may also decrease the likelihood of other psychological problems and adjustment disorders because both dropout and adjustment disorders result from a lack of self-regulation skills. Parental trainings on parenting attitudes and parent-child relationships may be implemented for parents in the scope of primary prevention studies because early maladaptive schemas based on relationships with primary care-takers are the main causes of many psychological problems like dropout. Moreover, preschool and primary school teachers may be given in-service training to support their students to develop their self-regulation and self-control skills and academic self-efficacy. School counselors may conduct both individual and group counseling to have students change their self-control perception from negative to more positive. Counselors may be given trainings about schema therapy as well as cognitive behavioral therapy to handle dropout more effectively.

This study investigated whether early experiences and insufficient self-control predicted dropout via the variable of early maladaptive schema. Since early maladaptive schemas show indirect effect of parental attitudes, studies taking parental attitudes as another variable may be carried out to find out the direct effect of parents' attitudes on school dropout. This study is a cross sectional study on high school students. Considering this limitation, longitudinal studies starting from early childhood years may be conducted.

Studies that compare dropouts and the non-dropouts may be carried out to examine the patterns of dropout process. Qualitative studies that interview both the at-risk students and the individuals who already dropped out of school may be conducted to comprehend this issue thoroughly. Consequently, this research will make prevention and intervention efforts more effective by providing more detailed and comprehensive explanation of dropout process. It will eventually reduce negative consequences of dropout at both individual and societal levels and enhance individuals' mental health.

Author (s) Contribution Rate

All authors contributed to the study (100%) conception and design, data collection, and analysis; they all read and approved the final manuscript.

Conflicts of Interest

The authors have no competing interests to declare that are relevant to the content of this article.

Ethical Approval (only for necessary papers)

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Creative Drama on Teacher Candidates' Speech Anxiety

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Creative Drama on Teacher Candidates' Speech Anxiety

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Abstract

Speaking skill is the most basic language skill that enables an individual to interact with his/her environment. The healthiness of both the university and professional processes of teacher candidates and the positive completion of their individual, social, and academic developments depend on good communication. Creative drama is a method that can be used for individuals to get to know themselves and their environment, to develop their social relations. and to experience them by doing and living together in a group. In the light of this information, the aim of the research is to determine the effect of creative drama on the speaking anxiety of teacher candidates. The participants of the study consisted of 21 teacher candidates studying in the undergraduate program of Turkish teaching, classroom teaching, and preschool teaching. In this research, mixed research method, and sequential explanatory design were used as a design. Quantitative data of the study were collected through the Speech Anxiety Scale (2012), and qualitative data were collected through interviews. The quantitative data of the research were analyzed statistically, and the qualitative data were analyzed by content analysis. When the quantitative and qualitative results of the study were examined, it was observed that the interest and love of the pre-service teachers who participated in the study increased, and their anxiety and worries decreased.

Keywords: Communication, Speaking skill, Speaking anxiety, Creative drama, Teacher.

Introduction

From the mother's womb, the individual tends to interact and communicate with his environmen. Thanks to this interaction, he makes himself accepted in the society he lives in. Communication is a tool that an individual uses to convey his needs, wishes, feelings, and thoughts to other people. In order to lead a good life, individuals need to communicate effectively and use their innate communication skills. Speech is an important communication skill because people often communicate by speaking. Therefore, speaking has a special place among basic skills. Speech: It is the verbal expression of one's feelings, thoughts, and experiences (Özdemir, 2004). People need to speak in order to prove their existence, to make themselves accepted, to provide satisfaction, to keep their environment under control, to improve their social relations, and to meet their needs (Arikan, 2011). While correct and effective speech can contribute positively to people's lives, wrong or inadequate speech can harm people (Özdemir, 2004). The language used to express feelings, thoughts, and wishes is considered a basic element of good speech (Vural, 2007). Spoken language differs from written language, and its effectiveness can be increased with features such as a rich vocabulary, correctuse of language structure and patterns, the style used by the speaker to express himself, a clear and understandable expression, an easy pronunciation and courtesy rules (Yaman, 2007).; Vural, 2007; Yıldız, 2014).

A speaker who lacks language skills may encounter problems and deficiencies during speaking. For this reason, speaking as a whole is an action where different physical and mental qualities such as cognitive readiness, correct expression, controlled breathing, and correct pronunciation should come together harmoniously (Akkaya, 2012). Speaking skill, which is an important element of communication, can be affected by factors that cause anxiety and stress for many people in public or one-on-one conversations. The individual's social, cultural, economic, physical, and psychological conditions can cause loss of self-confidence and dignity, which manifests itself in many areas, from daily conversations to public speaking (Sargin, 2006). Among these factors, especially speaking anxiety stands out as an emotion that negatively affects people (Katranci & Kusdemir, 2015). Due to anxiety, individuals are expected to behave shyly when speaking in front of the public (Sengül, 2016). However, individuals with speech anxiety should also make efforts to cope with these anxieties and improve their speaking

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skills instead of staying away from the act of speaking (Ayres & Hopf, 1993). Speech anxiety can also be name d as communication anxiety, and the individual's avoidance of communication (Richmond & McCroskey, 1998). Speech anxiety refers to situations in which the individual is afraid to speak (Ayres & Hopf, 1993). Individuals experiencing speech anxiety may react emotionally in the form of sadness, panic, anger, and physical sweating and rapid heartbeat while speaking (Demir & Melanlıoğlu, 2014; Dwyer, 2012). People with speech anxiety may be afraid of situations that require speaking skills. They may avoid negative criticism, feel bad by having difficulty speaking, and therefore avoid speaking as much as possible. Individuals showing these characteristics will have difficulty in communicating in a healthy way and this will cause an increase in their anxiety levels (Harb, G. C., Eng, W., Zaider, T., & Heimberg, R. G, 2003).

Although the ability to speaking, which makes people communicate with each other, is bestowed at birth, it is necessary to gain the ability to speak correctly and properly through education. There is a need for educators who use this skill correctly in order to ensure that students express their feelings, thoughts, dreams and wishes correctly in accordance with the rules of the language, which is one of the aims of the Turkish course. The success of an education system depends on the success of the teachers who will manage and advance the system in a healthy way. When training teachers, knowing only speaking skills will not be sufficient for a competent educator. The teacher is expected to set an example for the student by using the speaking skill correctly and effectively in the lesson. At this point, although there are many reasons why the teacher cannot use this skill correctly, anxiety is also one of the important reasons. Speech anxiety, which has been the subject of many studies since Clevenger's (1959) first mention of it in his statement, consists of two main elements: Anxiety in daily communication and anxiety arising from public speaking. It should be aimed at minimizing this anxiety, which can be seen in both styles of teaching. Because the teacher is responsible for gaining and changing behavior in line with the objectives determined by the language, which is the most important communication tool. The anxiety experienced while fulfilling this responsibility will cause the transfer to the students to be unsuccessful and inadequate. At this point, it is important to identify the problem while raising students. Looking at the relevant literature (Arhan 2007; Kusdemir & Katranci 2015), it is seen that pre-service teachers have speaking anxiety. It is possible to resort to many methods and techniques at the point of eliminating this anxiety. This in context individual speech is where your skill in the development can be used your methods at the beginning of the creative drama method is coming. Creative drama encourages creativity and plays an important role in personality development. It also improves the teaching effects on the individual in terms of language (Sha-sha FU & Gui-zhao YAO, 2020). Creative drama, individual and society in front by talking socialization and communication skills its development provides (Erbay & Sunay, 2010). Games, role plays, improvisations and animations used in creative drama have an important place in improving speaking skills and reducing anxiety (Aykac, 2011).

As seen in the related literature, creative drama can be used as an effective method in both the development and correction of individuals' communication skills. In this context, it was aimed to improve the speaking skills of teacher candidates with creative drama both during their undergraduate education and in their professional lives and to reduce their anxieties and worries about speaking skills. After this application, the experiences of preservice teachers on speaking anxiety were examined with the creative drama workshops. For this purpose, the following sub-problems are addressed:

- a. Do creative drama practices have an impact on teacher candidates' speech anxiety?
- b. What are the experiences of teacher candidates with speech anxiety of creative drama practices?

Method Research Pattern

In this research, a mixed method was used in which both qualitative and quantitative research methods were used together, and a sequential explanatory design was used as the design. Quantitative and qualitative data obtained in mixed methods research can be used to check the accuracy of each other, to support each other, to better explain situations where one of the data collection tools is insufficient, and to alternate with each other during the research. In the sequential explanatory design, the quantitative data of the research are first collected, analyzed and then explained in detail by supporting the quantitative data with qualitative data (Creswell & Creswell, 2018). In this research, first, quantitative data were collected, and then this design was preferred since the quantitative data were supported by qualitative data.

In the quantitative part of the study, a single-group pretest-posttest weak experimental design was used. In this design, the effect of the experimental procedure is tested with a study on a single group, and the measurements of the dependent variable of the subjects are obtained by using the same subjects and the same measurement tools as a pre-test before the application and a post-test afterwards. (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, &

Demirel, 2018). In this study, this design was preferred because pretest-posttest measurements were made with the same measurement tool for a single group.

In the qualitative part of the study, the phenomenology design was preferred. Phenomenology aims to discover the common meaning of the lived experiences of several people regarding a phenomenon or concept (Creswell, 2013). In this study, the phenomenology design was preferred because it examined how the students who just started the university make sense of their experiences of creative drama practices during the university adjustment process.

Working Group

In this study, criterion sampling, one of the types of purposeful sampling, was used. In criterion sampling, a study group can be formed according to the criteria created by the researcher or determined beforehand (Yıldırım & Şimşek, 2008). The participants of this study consist of 7 students from the classroom teaching department, 8 students from the Turkish teaching department, and 6 students from the preschool teaching department, all of whom are studying at a state university located in the Eastern Anatolia Region. The criteria of the study can be expressed as being a student of the faculty of education and having speaking anxiety. Demographic information about the participants is given in detail in Table 1.

Table 1. Demographic information of the participants

Chapters/Code Names	P1(Kader)	P2(Mehmet)	P3(Faruk)	P4(Sedef)	P5(Meryem)	P6(BEyza)	P7(Büşra)	P8(Basri)	P9(Fulya)	P10 (Aslı)	P11(Ilayda)	P12(Gülben)	P13(Sinem)	P14(Ceyda)	P15(Simge)	P16(Meltem)	P17(Derya)	P18(Ahu)	P19(Ahmet)	P20(Rabia)	P21(Damla)
Classroom teaching	+		+			+	+							+					+	+	
Turkish teacher		+			+			+	+	+						+	+				+
Pre-school teaching				+							+	+	+		+			+			

Data Collection Tools

In this study, quantitative data were collected through the Speech Anxiety Scale for Teacher Candidates developed by Sevim (2012). The Speech Anxiety Scale for Teacher Candidates (2012) was chosen to be used in this study because it consists of speaker-focused anxiety, environment-focused anxiety, and speech psychology sub-factors.

The qualitative data of the study were collected using interviews. Interviewing is used to learn about unobservable behaviors, emotions, or how people express the world around them. A semi-structured interview helps to open the subject with different questions, examine it from various angles, and reach new ideas about the subject in the speaking process (Merriam, 2018). In this study, the participants were interviewed in order to obtain data that could not be obtained quantitatively and examine them from various perspectives.

Data Collection

The pre-test data of the University Adaptation Scale (2020), which is the quantitative data collection tool of the research, were collected by the first researcher at the beginning of the "meeting" workshop, which was the first creative drama workshop, and the post-test data were collected six weeks later by the first researcher at the end of the "evaluation" workshop, which was the last creative drama workshop. The University Adaptation Scale (2020) was converted into Google Form format by the second researcher and sent to the students digitally in the creative drama workshop. The consent of the participants was obtained by placing the voluntary consent form on the first page of the digital scale. In the digital form prepared by the second researcher, the "necessary" button was marked for each item on the scale, so that data loss was prevented. A total of 12 creative drama workshops were conducted with the students by the first researcher during the implementation process of the research. Each workshop lasted 2 hours (120 minutes). Detailed information on the content and timing of the workshops is given in Table 2.

Results

Findings and Comments Obtained from the Analysis of Quantitative Data

In this section, the findings related to the quantitative data of the research are given.

Findings Related to the First Sub-Problem

The first sub-problem of the study was "Do the speaking anxiety scores of the experimental group students differ significantly between the pre-test and post-test scores?" in the form. Findings related to the first sub-problem are analyzed in this section.

Speech Anxiety	Ν	$\overline{\mathbf{X}}$	S	df	t	p *	Cohen 's
Pretest	21	2.5	.93	20	3.77	.001	.50
Posttest	21	2.1	.82				
* 0.05							

*p<0.05

In Table 3, it is seen that there is a significant difference between the SDL pre-test and post-test averages of the teacher candidates to whom creative drama was applied. According to the arithmetic averages, it is seen that the students' SDL pretest scores are \overline{X} =2.5 and posttest scores \overline{X} are =2.1. Significant differentiation is in favor of posttest scores (t₍₂₀₎=3.77 p<.05). When the data is examined, it can be said that creative drama is medium-sized (Cohen's d=.50) effective in reducing speech anxiety. (Pallant, 2016). It can be said that the creative drama application is effective in reducing the speaking anxiety of teacher candidates.

Table 4. Speaker-Oriented Anxiety Sub-Factor Pretest and Posttest Scores t-Test Results

Speaker-Oriented Anxiety	Ν	X	S	df	t	p *	Cohen 's
Pretest	21	2.55	.95	20	4.3	.000	.54
Posttest	21	2.1	.84				
*							

*p<0.05

In Table 4, it is seen that there is a significant difference between the speaker-focused anxiety pretest and posttest averages of the teacher candidates to whom creative drama was applied. According to the arithmetic averages, it is seen that the speaker-focused anxiety pretest scores of the students $\overline{X}=2.55$ and the posttest scores $\overline{X}=2.1$. Significant differentiation is in favor of posttest scores $(t_{(20)}=4.3 \text{ p}<.05)$. When the data is examined, it can be said that creative drama is medium-sized (Cohen's d=.54) effective in reducing speaker-focused speaking anxiety. (Pallant, 2016).

Table 5. Environmentally Focused Anxiety Sub-Factor Pretest and Posttest Scores t-Test Results

Pretest 21 2.41 1	20	2.6	.019	.48
Posttest 21 2 .85				

*p<0.05

Table 5, it is seen that there is a significant difference between the pre-test and post-test averages of environmentalfocused anxiety among teacher candidates who have been given creative drama. According to the arithmetic averages, it is seen that the environmental anxiety pretest scores of the students \overline{X} are =2.41 and the posttest scores \overline{X} are =2. Significant differentiation is in favor of posttest scores (t₍₂₀₎=4.3 p<.05). When the data are examined, it can be said that creative drama is effective in reducing environmental-oriented speaking anxiety with a small size (Cohen's d=.48). (Pallant, 2016).

Speech Psychology	Ν	$\overline{\mathbf{X}}$	S	df	t	p *	Cohen 's
Pretest	21	2.46	.99	20	2.62	.016	.55
Posttest	21	2	.83				
*p<0.05							

Table 6. Speech Psychology Sub-Factor Pretest and Posttest Scores t-Test Results

In Table 6, it is seen that there is a significant difference between the speech psychology pre-test and post-test averages of the pre-service teachers who applied creative drama. According to the arithmetic averages, the speech psychology pretest scores of the students were $\overline{X}=2.46$ and the posttest scores \overline{X} were =2. Significant differentiation is in favor of posttest scores (t₍₂₀₎=2.62 p<.05). When the data are examined, it can be said that creative drama is medium-sized (Cohen's d=.55) effective in reducing speech psychology anxiety. (Pallant, 2016).

Findings and Comments Obtained from the Analysis of Qualitative Data

The findings obtained from the interviews were examined in this section under the themes of speech anxiety, speaker development, environment-oriented development and speech psychology development.

		ayda	dnan	arık	etül	asri	ıci	aruk	rdem
Codes	f	İİ	A	Г	В	В	İı	Ц	Щ
Improving public speaking	7	+	+	+	+	+	+		+
Developing impromptu speaking skills	5	+			+	+		+	+
Developing self-expression skills	5	+		+	+		+	+	
Adjusting the tone	4	+		+			+		+
Developing prepared speech skills	3			+		+	+		
Adjusting the speaking rate	2			+					+
Improving pronunciation	1			+					
Improving stuttering	1					+			

 Table 7. Participant Views on the Speaker Development Category

As seen in Table 7, Erdem, one of the participants who stated that creative drama practices completely eliminated the anxiety of public speaking, said, "As I said before, I was getting excited. For example, speaking in front of a public I can say that the biggest contribution of drama has been to me. It gave me self-confidence. Before, I could not speak in front of a community, even in front of 3-4 people, but now I have reached the level of speaking in front of 150-200 people. For example, I was saying that 5-6 people came, and I was ashamed to even go and say hello. But at the point we've reached now, after the drama workshop, if they say there are 200-300 people, I can go on stage and speak." he stated. Faruk, one of the participants, who stated that the impromptu speeches they made during the creative drama improved their impromptu speaking skills in daily life, said, "It was difficult for me to act and adapt to the subject when the subject was given impromptu at work, and it was obviously unnecessary to me, I did not know the effects in it. But, while I was in the drama, I realized how effective the drama was in that time period, how it affected our thoughts and how it improved our speaking ability." he stated. Betül, one of the participants who stated that she was able to express herself better after the creative drama practices, said, "...I am in a good position because I can express myself more easily in this." she stated. Erdem, one of the participants who stated that he could use his tone more effectively after creative drama, said, "For example, in a classroom where there are 20-30 people, I can adjust my tone so well that I can rest the whole class. I can turn it down and up in an instant I think that drama contributed to all of this." commented Basri, who stated that his prepared speech skills such as lecturing, making presentations, and presenting improved after the creative drama, said, "It would be good to say that it contributed to the prepared speech. ... when we repeat in the evening, I can come here and talk." stated. Erdem, one of the participants who complained about his speaking speed before the drama but stated that he improved his speaking speed afterwards, said, "I was speaking fast, I tried to speak slowly. Of course, I got support from my friends in this regard. He contributed a lot to that. This is one of the most contributing topics." he stated. One of the participants said that he was worried about the pronunciation of Tarik, but after the drama his pronunciation improved. It's still not quite good, but I'm speaking more clearly, so I think it's good." stated. Basri, one of the participants, said that he had a stuttering problem before the creative drama, that he could not overcome this issue and that he made progress after the creative drama said: "Tugrul teacher makes us read texts. In the class of 60 people, I cannot say, "Teacher, I have a stutter". I

hide behind it, but I can't say anything. Now I can say this with peace of mind. Why? I'm starting to get over it. After that, after the drama, I said, "Yah, I can get over this".

Codes	f	İlayda	Adnan	Tarık	Betül	Basri	İnci	Faruk	Erdem
Improving communication with authority	7	+	+	+	+	+		+	+
Talking to strangers Talking at home Improving business communication	7 2 1	+	+	+	+	+ +	+		+ + +

Table 8. Participant Views on the Environment-Focused Development Category

In Table 8, participants stated that creative drama helps reduce shyness towards people with authority. Ilayda, one of the participants, said about this issue to the faculty members: "For example, there were high-level people at the accreditation meeting we went to recently. There were academics from different universities, and I did not feel nervous while talking with them. I was able to express myself very easily. I was able to speak. For example, while emphasizing that I could not do these things before ", Betül emphasized that she had improved her communication with the local administrator, "Actually, when I went home, I saw the district governor during the break, he stopped by my father, so I could easily talk to him, it may have an effect on this, but I never thought about it from this perspective. I was able to express this easily in the district, or if it had been before, I could not have expressed it so easily." She emphasized. Tarik, one of the participants who thought that creative drama made it easier to overcome the anxiety of speaking with people he did not know, said, " I would speak clearly even if I had a hundred friends among my own friends, but there was a fear of stumbling against strangers even if it was three people, that is, a fear of being wrong in what I said. I don't have any fear right now. "he stated. Basri, one of the participants, who stated that the conversations with family and relatives improved after the practices, said, "It has had an impact on both my speaking angle, my self-expression, and my social life. It even affected my family. If I say something like overcoming difficulties, it is the place for drama.". Erdem, who stated that after the creative drama, his anxiety towards the people he talked to about daily tasks disappeared, said: "For example, when I was talking to the grocery store, I was a person who hesitated even about bargaining. I mean, there was something in me as if something bad was going to happen at any moment. Thanks to drama, I was able to communicate more easily with both tradesmen.

Codes	f	İlayda	Adnan	Tarık	Betül	Basri	İnci	Faruk	Erdem
Admitting speech deficiencies	4				+	+		+	+
Providing self-control	4	+		+	+			+	
Breaking prejudices	4			+	+		+		+
Understanding the other party in the	4			+	+		+	+	
conversation									
Gaining self-confidence	3	+		+					+
Relaxing	2	+				+			
Controlling your body	2	+					+		
Deepening conversation topics	1							+	
Not comparing	1					+			

Table 9. Participant Views on the Category of Speech Psychology Development

When Table 9 is examined, one of the participants who stated that they were able to accept the speech deficiencies that they were aware of but could not accept after the creative drama practices, Erdem said, "*The biggest thing that happened in that process was that I faced myself there. Actually, maybe I knew them. I had a lack of self-confidence, there was a problem in my address and speech ... I actually knew these things, but I couldn't admit it to myself. There I thought I'd actually admit it to myself. So it made me say to myself why not confess. "he stated Faruk, one of the participants who stated that he gained self-control while talking after the creative drama, said, "After participating in the drama, I realized that I explained my thoughts in a more organized way compared to the past... I learned to express my thoughts in a more concise way, and with it I learned that not every thought*

should be said out loud. "stated. One of the participants, who was prejudiced and anxious while talking to people before the creative drama practices, but stated that these prejudices were broken after the practices, Inci said, ' Did anyone say anything? Did he make fun of me? You think this way, after the drama, we learned a lot, we learn from the drama that we have to act prejudiced and communicate effectively with people." she stated. Faruk, one of the participants who stated that he tried to understand the people he was talking to during the workshops, and that these skills had improved, said: "... I used to directly express my ideas, my thoughts and my feelings, regardless of what the other person thought, (laughing) With the effect of the drama, I corrected it a little, so yes, the thoughts and feelings of the person on the other side are also important because when you offend the person on the other side, your relationship with them weakens. " he stated. Tarik, one of the participants, who stated that the creative drama workshop helped him gain self-confidence in speaking, "I used to be a shy student. Especially during high school. I was active but still getting a little excited in public or something. I got a little excited at our first workshop. I wonder how I look, if my posture is good or something, and then I slowly opened up. I even made a presentation because of you. I could speak clearly. I didn't have any fear." Expressing that she reminds herself of her experiences in drama when she is worried, lavda said, "There is tension, excitement, but I can feel more comfortable and I can relax. Ilayda wake up, I can relax by saying that it's not so important that you have made different moves among many people for months in the drama. I believe I can succeed.". Basri, one of the participants who stated that he contracted a lot during the speech, but relaxed in the speeches after the creative drama, said, "Yav teacher, I was twitching a lot. ... We came to the drama, we laughed, we had fun. Seriously, I laughed and had fun. It gave me something. We used to say that there are some absurd movements in the drama. But it wasn't improper. I learned them at the end of the drama." stated. One of the participants, who stated that she got over her excitement and was able to control her body after the creative drama practices, thought inci said: "... I remember that Tugrul teacher, for example, put me on the board before the drama (laughing). I'm blushing or something, Tugrul Teacher brought me back to the blackboard after the drama, I expressed myself very well, I think the drama had an effect on this." she stated. Expressing that creative drama workshops deepen the conversations with his friends, Faruk said: "When we look at our conversation content after the drama, I always compare all of them after the drama and before the drama" We had discussed Shakespeare's King Lear and I wrote a book analysis .". Basri, one of the participants, said that he compared himself to people who spoke better before the drama, but that this comparison disappeared after the drama, " ... I envy how well they talk. I was counting the minutes so that it wouldn't be my turn. I was saying, "Don't let it be my turn, I can't talk like these." It was like that in the beginning, sir, You know our Ferit, Ferit has a very good diction, He's up and talking. At that time, I say, "Don't be my turn. I can not do." Look how well he spoke. I would be ashamed if I could not speak like him." I was saying. Now if Ferit came and spoke very well here, I would not be offended if I spoke badly. Drama contributed a lot." stated.

Discussion and Conclusion

The mother tongue education, which is taken together with school, may not be enough to use the four basic language skills that are expected to be learned and developed. Although there are many reasons, anxiety is one of the important causes of this inadequacy. The fear of receiving negative criticism, especially during speaking, causes the individual to run away and feel bad in situations where speaking skills should be used (Melanlioğlu, Demir, 2014, 110). Public speaking anxiety, which has various names such as fear of public speaking or fear of speaking in front of others, is a very common condition (Pull, 2012). When the findings of the study were examined, it was concluded that creative drama relieved speech anxiety. The quantitative and qualitative findings of the study on this subject support each other. When we look at the literature, it is seen that many methods (roleplaying model, academic contradiction method, microteaching technique, academic contradiction method, direct instruction model) seem to have positive effects on speaking anxiety in parallel with the results of the aforementioned study (Bulut 2015; Regulation 2016; Boneless 2016; Uzunyol 2019; Unsal 2019). However creative in drama individual physically aspect active to be And created by social environment nature with group to your interaction open the one which... structure of drama speech in the skill experienced anxiety in the process A lot your method before passing through positive effect to create facility is recognized. In Codur (2019) study speech his anxiety physically with activity together evaluated and physically to activities participation high the one which... of persons speech of anxiety low is to the conclusion by reaching in the drama physically your activities speech in the skill anxiety in troubleshooting to the effect mentioned. In the studies used method and speaking techniques skill and anxiety on you positive effects evelash before taken, four basis language your skill in acquiring of drama from the possibilities language (Sever, 2001) in teaching traditional your method outside exiting diversification required.

Looking at the quantitative data of the study, it has been shown that the application of creative drama is effective in reducing the speech anxiety of teacher candidates. In another sub-problem, speaker-centered anxiety, it is seen that there is a significant positive differentiation after the creative drama application. When we look at the literature, many studies in which creative drama increases self-confidence and gain self-confidence (Guida, 1995; Yassa, 1999; Philips, 2003; Freeman et al., 2003; Aribal, 2006, Jindal-Snape et al., 2011) is seen. Švábová also did (2017) with work of drama group interaction thanks to self-confidence has increased emerge putting social qualities thanks to created by positive from interaction promise it does. This situation supports the correct and effective use of speaking skills by reducing the anxiety caused by the speaker. Similarly, creative drama was found to be effective in speech psychology anxiety. Sometimes the anxiety is not related to the speaker himself, but may be caused by the environment. When the data are examined, it is seen that creative drama is effective in reducing environmental-oriented speaking anxiety. Yang (2007) supports that drama relieves the individual's communication with his environment and reduces the speech anxiety experienced by the individual. The qualitative data of the study also support the quantitative data. Speech The theme of anxiety is discussed in the categories of speaker development, environment-oriented development and speech psychology development. From the perspective of speaker development, pre-service teachers show that especially creative drama improves public speaking. In the creative drama process, participants and trainers exhibit improvisational behaviors, so the speaking participants generally have to improvise (Metinnam, 2022). Participants are very careful in this process in order to both express themselves as speakers and understand others correctly. In this process, which develops with the active participation of the participants in the warm-up, animation and evaluation sections, speaking is always at the forefront. This situation improves the speaking skills of the participants as well as eliminating their anxiety about speaking. The process of presenting the animations prepared individually or in groups, especially during the animation phase of creative drama, requires the direct use of speaking skills in front of the community. As a result of this situation, speaking in front of the public becomes an extremely ordinary act for the participants. Speaking effectively in front of the public is very important for prospective teachers who need to address the classroom or school when they start their careers. At the same time, it is seen that their anxiety decreases in both prepared and impromptu speaking skills and they express themselves more easily. During the process, the participants can realize their own shortcomings while speaking in front of the public and can address these shortcomings in their next attempts. Creative drama gives participants the opportunity to express themselves in any way they want, giving them the opportunity to try new things. Participants in these moments of expression gain skills such as controlling themselves while speaking unprepared, following the interest and relevance of others at the time of speaking, adjusting the tones of voice, and adjusting the speaking speed. In the applications made in this research, some activities such as having the participants perform their animations within a certain period of time and giving a speech by giving a certain word limit resulted in the development of these skills of the participants. The development of these skills has a positive effect not only on impromptu speeches, but also on the development of prepared speaking skills such as making presentations, lecturing, and speaking at conferences, thus positively affecting the speeches of the participants in all areas. Although it is not the focus of the study, the development of a speech disorder of a participant who has problems with stuttering through creative drama is also among the important results.

In the environment-oriented development category, all of the pre-service teachers revealed that the shyness and anxiety they experienced in communicating with the authority disappeared over time. The instructor (facilitator) who conducts the creative drama process should not display a strict and oppressive attitude to the participants like a teacher, leader or manager; on the contrary, being a part of the process, facilitating the process and having a moderate attitude affect the participants' perspectives towards authoritarian people. This situation, which reflects positively on relations with authoritarian people, also shows itself in speaking with authority. In addition, the reflections of this situation are seen not only in the conversations with the creative drama trainer, but also in the conversations with different authoritative people in daily lives. Similarly, it is seen that the problems experienced in communicating with people they do not know have decreased. The developments in the workshop during the creative drama process are also reflected in the daily life of the participants. In creative drama, participants have to communicate with people they do not know, and this improves their communication with strangers. This communication skill also shows its effect outside the workshop as well as inside the workshop. The participants, who talked to people they did not know during the process, did not experience anxiety when talking to people they did not know in their daily lives. Creative drama, in which real life is rehearsed during the animations, makes itself felt in real life, both in daily work and in social life, in a positive sense. Since individuals with social phobia experience more anxiety during speaking, (Heiser, Turner, Beidel, & Roberson-Nay, 2009) it can be thought that the improvement of the participants' social phobia in creative drama reduces their speaking anxiety.

The creative drama about the psychology of speech decreased. Since creative drama offers the participants the opportunity to face themselves in a transparent process, it becomes easier for the participants to accept themselves in this process. Since no one is judged for a speech or action during the creative drama process, the participants act comfortably while speaking and exhibiting a behavior. This allows them to relax and gain self-confidence while speaking. Individuals who gain self-confidence in speaking are not affected by making mistakes or negative attitudes of others while speaking (Atas, 2015). In addition, since the participants have the opportunity to observe themselves and other participants while speaking, they can control themselves physiologically and

psychologically while speaking, and as a result, they can realize their speech deficiencies and improve them. Since creative drama is a social process, participants often talk to other people and observe the speech and action performances of different people. This results in the development of skills such as better understanding and empathy at the time of speaking. One of the important results is that one of the participants stated that he compared himself with a participant whose speaking skill he thought was better than himself, but at the end of the process he did not make this comparison anymore. This situation can be interpreted as an indication that creative drama plays an important role in self-acceptance. Since creative drama can take "everything" as a subject, workshops can be about "everything". In this process, the participants can even think long and hard on ordinary objects and make deep speeches from them. As a result, participants can be motivated to have deeper conversations in their daily conversations.

As a result, since creative drama is an action-based improvisation process that offers individuals the opportunity to express themselves comfortably and every thought, speech and action is accepted, the participants reduce their speaking anxiety in this process. In essence, it can be stated that this process, which allows people and their thoughts to speak freely, significantly reduces speech anxiety.

Authors Contribution Rate

The authors contributed equally to the paper.

Conflicts of Interest

Authors declare that they have no conflict of interest.

Ethical Approval

The ethics committee approval of this research was obtained from the Social and Human Sciences Scientific Research and Publication Ethics Committee of İnönü University Scientific Research and Publication Ethics Committee with 2/8 sessions and resolutions on 01.02.2022.

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Reviewing the Factors Affecting PISA Reading Skills by Using Random Forest and MARS Methods

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Reviewing the Factors Affecting PISA Reading Skills by Using Random Forest and MARS Methods

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Abstract

The research aims to determine the factors affecting PISA 2018 reading skills using the Random Forest and MARS methods and to compare their prediction abilities. This study used the information from 5713 students, 2838 (49.7%) male and 2875 (50.3%) female, in the PISA 2018 Turkey. The analysis shows the MARS method performed better than the Random Forest method. In both methods, the most significant factor affecting reading skills in Turkey is "the number of books in the house." The variables the MARS method finds significant are "students' perception of difficulty, motivation for reading skills, father's educational status, reading pleasure, bullying experience of the student, mother's educational status, attitude towards school, classical artifacts at home, supplementary school books at home, competition at school, competitive power, cooperation perception at school, reading frequency, self-efficacy, poetry books at home, anxiety about reading skills, and teacher support." However, the other variables had no relationship to prediction. This study is expected to serve as a model for the use of data mining in educational research.

Keywords: Educational Data Mining, MARS, PISA, Random Forest, Reading Skills

Introduction

Along with the national assessment studies in the field of education, applications such as TIMSS, PISA, and PIRLS are carried out to enable countries to see their position on an international scale (Chang & Bangsri, 2020; Ministry of National Education [MoNE], 2019). One of these exams, the Program for International Student Assessment (PISA), which was developed by the Organization for Economic Cooperation and Development (OECD), is educational research that measures the ability of an age group of 15 students enrolled in formal education to apply the knowledge and skills they have acquired throughout their school life into daily life. In the PISA applications conducted every three years, students' reading skills, mathematics literacy, and science literacy levels are measured, and a different field is emphasized in each application period. In PISA applications, apart from three fields, information about the student's motivation, thoughts about himself, learning styles, school, and family environment is collected (MNE, 2019). In the last PISA application in 2018, reading skills were determined as the main field (MNE, 2019).

Reading skills are defined as the individual's capacity to understand, use, evaluate, think about, and communicate about the texts to achieve his or her goals, develop his/her knowledge and potential, and participate in society (Ikhsanza et al., 2019; OECD, 2019; Urfalı Dadandı et al., 2018). The definition of reading skills has changed in line with economic, cultural, and technological developments. Reading should not only be understood as a skill acquired during childhood. Reading skills are significant tools in lifelong learning that enable individuals to interact with their peers and society (OECD, 2019). In other words, reading skills are a key to success not only in the academic field but in all fields of life (Ikhsanza et al., 2019). Therefore, reading skills can be considered the power to understand and use printed information in daily activities that help individuals reach their goals and increase their knowledge and potential. Therefore, within the framework of PISA reading skills, such aspects as a student's ability to access, select, interpret, combine, and evaluate information are considered (OECD, 2019).

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In the PISA 2000 application, which was the first cycle of PISA, the reading skills competence levels were determined under five categories; this number was then increased to six in the 2009 application. In this period, the name of level 1 has been changed to level 1a, and level 1b categories have been added. Unlike these, in the PISA 2018 application, the scope was expanded by adding Level 1c to the reading scale, which better defines the competencies of the lowest-achieving students. The aim here is to increase sensitivity in measuring reading skills and to try to understand what students in this situation can do while reading (Arici & Altintaş, 2014; OECD, 2019). Besides, in the reading skills category in previous PISA applications; there were three sub-scales named "accessing and obtaining information", "integrating and interpreting texts" and "reflecting on and evaluating texts". In the PISA 2018 application, the names of these scales were changed to "finding information", "understanding" and "evaluating and reflecting". Also, in this period; two new sub-scales that define students' literacy with single-source and multi-source texts were also developed.

Thanks to large-scale examinations such as PISA, countries have the opportunity to see where they rank among the participating countries and draw comparisons with other countries on specific areas relating to education (Torney-Purta & Amadeo, 2013). Turkey participated in a PISA application for the first time in 2003, and in these applications made in the field of reading skills so far, it has been seen that Turkey is below the OECD average (Bozkurt, 2016; Urfalı Dadandı et al., 2018). In the 2018 PISA reading skills field, the average for Turkey is 466, the average for the OECD is 487, and the average for all countries is 453 points. In this cycle, Turkey has increased its average score according to PISA 2015. Despite this, it ranks 40th out of 79 participating countries in the field of reading skills. When the performance was examined according to their competence levels, it was seen that students concentrated on levels 1a and 2 (MoNE, 2019). In PISA applications, Turkey trails behind OECD countries in terms of mathematics and science literacy, as well as reading skills. In the literature, there are studies suggesting that reading skills affect mathematics and science achievement (Gülec & Alkıs, 2003; Güre et al., 2020; Gürsakal, 2009; İnal & Turabik, 2017; Kaya, 2017). Therefore, it is clear that the data to be obtained in the analysis of multifaceted information gathered at a large scale level through the applications carried out at an international level like PISA are of vital importance. In the analysis of such data, it is likely to unveil the hidden structure and analyze the big data through powerful methods without errors due to the existence of data mining methods. In fact, in the examination of the data obtained from such large-scale applications, it has been seen that there are numerous studies in the literature in which data mining methods are used (Aksu & Doğan 2018; Gamazo & Martínez-Abad, 2020; Güre et al., 2020; Martínez-Abad et al., 2020). Among these studies, there are several that utilize the Random Forest method, one of the existing methods that use PISA data (Aksu & Doğan 2018; Güre et al., 2020; Han et al., 2019; Saarela et al., 2016; Yi & Na, 2020). In addition, it has been found that there is a study in which the MARS method is used (Kılıç Depren, 2018). However, in the related literature, there is no study encountered in which the two methods are used together in the field of education. It has been observed that although a limited number of studies using the MARS method have been encountered (Kayri, 2010; Şevgin & Önen, 2022), there are numerous studies utilizing the RF method (Behr et al., 2020; Mahboob, Irfan & Karamat, 2016; Pelaez, 2019; Petkoviç et al., 2016).

In the present study, it is aimed to investigate, using data mining methods, the factors affecting the reading skills of 15-year-old students who are enrolled in formal education in Turkey. The PISA 2018 data were examined utilizing data mining methods such as Random Forest and MARS, and the classification performance of the approaches as well as the factors affecting students' reading skills according to both approaches were revealed according to their importance. To that end, RF and MARS were used to analyze the relationships between the factors influencing students' reading skill levels in Turkey, and answers to the following questions were sought:

1. What is the significance level of the variables in the model according to these Random Forest and MARS methods?

2. Do the classification performances of these two methods differ?

Methodology

The present research is a descriptive study using a relational survey model, which is one of the most common survey models. The relational survey model is a research methodology that aims to describe the existence of the interaction between many variables as it is (Karasar, 2006).

Data Set

More than 600,000 students participated in the PISA 2018 application, representing 32 million students in the age group of 15 and studying in 79 participating countries (of which 37 are OECD members) (MoNE, 2019). A random selection of 6890 students from 186 schools attended to PISA 2018 Turkey application based on 12 regions according to Nomenclature of Territorial Units for Statistics (NUTS) Level 1 (MoNE, 2019). Students with missing data from demographic characteristics were excluded from the data set prior to analysis. The regression method was used for the student characteristics collected at the Likert type scale level for the variables that were found to be significant as a result of the missing data analysis at each scale level and contained less than 5% missing data, and deletion was used for the variables that contained more than 5% missing data. As a result of the missing data procedures, the data collected from 5713 students—2838 (49.7%) male and 2875 (50.3%) female — who took the PISA 2018 were used.

Measuring Tools

In this study, as a data collection tool as well as a PISA 2018 student survey of Turkey, the scales, the difficulty perception, the competitiveness perception at school, the cooperation perception at school, the attitude towards school, the sense of belonging to the school, the students' bullying experience variables, and the scores obtained from the reading skills test were used.

In the research, first of all, the variables that had the likelihood of being associated with one another and that were thought to affect reading skills were examined and selected based on the theoretical framework. In the scope of the research, the scores obtained from the scales Teacher Support, Reading Frequency, Reading Pleasure, Reading Fluency, Student Motivation Scale, Student Anxiety Scale, and Self-Efficacy Scales were used. Moreover, within the scope of the study, in addition to the scales used, certain demographic and personal information about the students was also used. (Table 1).

Predictor	Categories	%
Candar	Female	50.3
Gender	Male	49.7
	High School	23.8
	Vocational / Technical High School	15.6
Mother's Educational Level	Secondary school	22.4
	Elementary school	28.2
	Not Graduate from Elementary school	10.0
	High School	25.4
	Vocational / Technical High School	21.8
Father's Educational Level	Secondary school	27.4
	Elementary school	21.6
	Not Graduate from Elementary school	3.8
	Yes	74.9
Do you have your own room in your nome?	No	25.1
De sur herre electric estate in sur herre?	Yes	74.1
Do you have classic artefacts in your nome?	No	25.9
	Yes	59.6
Do you have poetry books in your nome?	No	40.4
	Yes	88.6
Do you have supplementary textbooks at nome?	No	11.4
De sur herre e distingues in sur herre 9	Yes	96.4
Do you have a dictionary in your nome?	No	3.6
Do you have art, music and design books in your	Yes	44.3
home?	No	55.7
	0-10 book(s)	15.6
	11-25 books	26.1
	26-100 books	31.2
now many dooks do you nave in your nome?	101-200 books	14.2
	201-500 books	9.1
	More than 500 books	3.9

Table 1. Descriptive statistics of predictor variables

As the dependent variable in the study, reading skills at the student level were used by taking the average of ten different possible (PV1READ-PV10READ) values in terms of cognitive domain competence. The average scores

were grouped according to the threshold values of the PISA 2018 reading skills competence levels, and then the competence levels were converted into a two-level categorization as successful and unsuccessful (Table 2). In this case, the predicted variable in the model was transformed into a categorical structure.

Competence levels	Score (X)	Category
level 1c	189 < X <261	Unsuccessful
level 1b	262 < X <334	
level 1a	335 < X <406	
level 2	407 < X <479	
level 3	480 < X <552	Successful
level 4	553 < X <625	
level 5	626 < X <697	
level 6	above 697	

Table 2. PISA 2018 threshold values and categories of reading skills competence levels

Analysis

Within the scope of the study, in the application of RF and MARS methods, SPM (Salford Predictive Modeler), SPSS, and MS Excel programs were used. The SPM program uses the source codes written by Breiman and Cutler in the Fortran programming language (Akman et al., 2010). In the program; algorithms such as CART, Random Forest, MARS, and Gradient Boosting can be run. In the study, the educational version of the SPM program was used. After downloading the data file containing the PISA data, it was first converted to Excel format and transferred from Excel to the SPSS environment. Data deletion was performed in SPSS, descriptive statistics of the variables in the model were obtained, and the Likert-type scales used in the research were converted into a Z-point with the same mean value and standard deviation due to the various numbers of categories. With the demo version of the SPM 8.0 program, predictions were made for the RF and MARS methods based on default values, and performance indicator values related to the predictions were obtained.

Random Forest Method

The Random Forest (RF) method, developed by Breiman in 2001, is a well-known method as a classification and regression method. The method, one of the Ensemble methods, is based on the idea of combining decision trees with clustering and bootstrapping ideas (Biau & Scornet, 2016; Genuer et al., 2017).

The RF method has high prediction performance even in cases where the number of variables is greater than the number of observations, there are many missing observations, and compliance is excessive (Biau & Scornet, 2016; Cutler et al., 2007). The method is fast, simple to use, has high classification accuracy, can work with small samples, and can be applied directly to high dimensional problems (Biau & Scornet, 2016; Cutler et al., 2011). The RF method attracts attention with its features such as measuring the proximity between samples in two ways, determining the significance levels of variables, assigning missing values, determining outliers, and unsupervised learning (Cutler et al., 2011). The ability to work with the desired number of trees and the absence of pruning or stopping rules make the method advantageous (Breiman, 2001; Quinlan, 1993).

The RF method can model complex interactions between predictor variables and work with statistical analysis methods such as regression, classification, and survival analysis (Cutler et al., 2007). It is reported that it is consistent compared to other methods due to its small generalization error (Breiman, 2001). RF method; while creating each tree, it uses different bootstrap samples according to the classification or regression trees it has composed. In standard trees, each node is divided by providing the best division among all variables; in the RF method, variables that provide the best division among the predictors randomly selected among all nodes, are used (Güre et al., 2020; Liaw & Wiener, 2002).

In the RF method, each tree sampled from the original data set in the decision forest is selected by using both the bootstrap sampling method and the random and replacement method (Breiman, 2001). In the method, each tree shows a similar distribution with all trees in the forest. Also, the method combines predictions based on the values of an independently sampled random vector. The generalization error of a tree classifier forest depends on the strength of each tree in the forest and the correlation between them. As the correlation increases, the error rate in the forest increases (Breiman, 2001). The method uses the CART algorithm to produce maximum size trees without pruning (Akman et al., 2011; Breiman, 2001).



Figure 1. The tree structure of the RF method (Özdarıcı Ok et al., 2011).

RF is accepted as a collection of predictors consisting of random-based regression trees defined as $\{r_n(x, \Theta_m, D_n), m \ge 1\}$ with outputs $\Theta_1, \Theta_2, \dots, \dots$ of the random variable. These random trees are combined with clustered regression estimates. The corresponding equality is shown below.

$$\bar{r_n}(\boldsymbol{X}, \mathcal{D}_n) = \mathbb{E}_{\boldsymbol{\theta}}[r_n(\boldsymbol{X}, \boldsymbol{\theta}, \mathcal{D}_n)]$$
(1.1)

In the equality; \mathbb{E}_{θ} conditionally indicates the expectation for the random parameter on X and the data set \mathcal{D}_n . θ random variable is used to determine how to make successive partitions in the creation of individual trees, for example, choosing the coordinate to be split and the split position. In the model in mind, it is assumed that the variable is independent of X and that the training example is \mathcal{D}_n . This shows that, especially, any bootstrapping or resampling steps in the training set are not accepted (Biau, 2012; Güre et al., 2020).

In the method, a model can be established by taking the entire data set as well as separating it into test and learning data sets. To create the RF algorithm; first, n pieces of bootstrap samples are selected from the original data set. Among these, 1/3 is used as training data, and the other 2/3 is used as learning data. Next, the un-pruned classification and regression trees are grown for each bootstrap sample. Instead of choosing the one that provides the best division among all the variables in the learning (inBag) data set, first m pieces of random samples are selected, and the one that will provide the best division among them is determined. Finally, by collecting the estimates of n pieces of decision trees, the new data set is estimated by considering the average for regression and the majority of votes for classification (Akman et al., 2011; Liaw & Wiener, 2002).

MARS (Multivariate Adaptive Regression Splines–MARS)

The MARS method is a nonparametric regression method developed by statistician Jerome Friedman in the early nineties. This analysis method, abbreviated and known as MARS, is generally translated into Turkish as "multivariate adaptive regression extensions". The MARS method, which has great significance in both classification and regression, is successfully applied, especially in science fields where complex relationships among many variables are modeled (Kuter et al., 2015). The MARS analysis method (Lindner, 2011), which is a particularly popular method in the field of data mining, enables more accurate estimation, easy understanding, and elaboration of regression models (Statsoft, 2017).

MARS determines the relationships between the dependent variable(s) and independent variables based on the "smoothing splines" logic. MARS is a very popular method used to develop models that can make accurate predictions, especially when there is no simple or monotonous relationship between the dependent variable and the independent variables, or when there are complex relationships with another expression (Lindner, 2011; Nisbet et al., 2009). Besides, the MARS analysis is a method that does not contain any assumptions regarding the functional relationship between dependent and independent variables (Friedman 1991).

MARS transforms nonlinear relationships between dependent and independent variables into a linear structure using appropriate transformation techniques (Deichman et al., 2002). MARS, which can automatically find connections and perform modeling between independent variables by creating nonlinear models, is based on the principle of revealing the model hidden in the database. This model is known to give good results, especially in data sets with more than one dependent variable (Statsoft, 2017). Besides, MARS, which effectively processes the loss data in the data set, can be regarded as unbiased due to its ability to divide nonlinear models into linear particles and make parameter estimates separately in each particle (Kayri, 2009).

The MARS analysis method essentially goes to create the most suitable model in two steps. In the first step, MARS creates the sum of basic functions, which are transformations of independent variables, taking into account deviations (nonlinear) and interactions in the model. In the second step, MARS estimates the basic functions as independent variables using the least-squares method (Deichman et al., 2002). Again, it tries to construct a flexible regression model by using basic functions corresponding to different intervals of independent variables (Friedman 1991). Besides, the selection of basic functions is data-based and specific to the problem studied, which makes MARS an adaptable regression technique for solving multidimensional problems. When creating the MARS model, partial linear basic functions are added to each other to determine the dependent variable, taking into account the additive and interactive effects of the independent variables (Kuter et al., 2015).

When creating the MARS model, partial linear basic functions are added to each other to take into account the additive and interactive effects of independent variables to determine the dependent variable (Kuter et al., 2015).

MARS is an ideal data modeling method for researchers who want to fully explain the relationships between variables besides using strong and accurate estimation (Friedman, 1991). Thus, the researcher gets the chance to gain insight into the business and make more strategic decisions.

Performance Criteria

As for performance criteria in the study, Accuracy rate, specificity rate, sensitivity rate, precision rate, F1 statistic values and AUC values of the ROC curve were used. Equations for performance criteria are given below.

Table 3. Complexity Matrix

		Predicted Class		
		Unsuccessful	Successful	Total
	Unsuccessful	TN	FP	TN+FP
Real Class	Successful	FN	TP	FN+TP
	Total	TN+FN	FP+TP	TN+FN+FP+TP

Correct classification rate = $\frac{(TP+TN)}{(TP+FP+TN+FN)}$	(1.2)
Specificity rate $=\frac{(TN)}{(TN+FP)}$	(1.3)
Sensitivity rate $= \frac{(TP)}{(TP+FN)}$	(1.4)
$Precision \ rate = \frac{(TP)}{(TP+FP)}$	(1.5)
$F1 - Statistics = \frac{2 + Sensitivity + Precision}{Sensitivity + Precision}$	(1.6)

Before the PISA 2018 data set was analyzed with RF and MARS methods, it was tested whether there was a multicorrelativity problem among the variables included in the analysis. In the multi-correlativity test, the Variance Inflation Factor (VIF) and the Tolerance values of the multi-correlativity are taken into account. If the VIF value is greater than 10 or the Tolerance value is less than 0.1, it is understood that there is a problem of multicorrelativity between variables (Güre et al., 2020; Keller et al., 2012). In this study, it was observed that VIF values varied between 1.059 and 5.458 and Tolerance values varied between 0.183 and 0.944. Therefore, it was understood that there was no problem with multi-correlativity among the variables used in the study.

Results and Discussion

Results

Significance levels of variables in the model according to both methods

The RF method is also an iterative method like the MARS method. In this method; the researcher can decide on the number of trees and the number of variables to be used. In the study, to determine the most appropriate number of trees for creating the decision forest; the analysis was repeated with the numbers of trees 250, 500, 750, and 1000. The value with the lowest error rate expresses the number of trees from which the most suitable model will be composed. The number of random variables to be selected in each node is taken as 5, which is the square root of 25, which is the total number of variables. The graph showing the error rates in the decision forest according to the number of trees is shown in Figure 2.



Figure 2. The overall error rate of the decision forest according to the number of trees

As can be seen in Figure 2, the error rate decreases starting from the first tree until the 788th tree, and it rises again after the 788th tree, where it has the lowest (0.286) value. This value refers to the number of trees required to build the new model. Thus, to create the most suitable model, the model was rebuilt with 788 trees, which had the lowest error rate. Predictor variables that affect the predicted variable in the established model are given in Table 4 in order according to their significance level.

Table 4. Significance levels of variables according to the RF method

Predictor Variables	Score	
Number of books at home	100.00	
The presence of classical artefacts at home	35.81	
Difficulty perception	34.34	
Father's educational status	29.15	
Mother's educational status	14.31	
Reading pleasure	13.38	
Presence of supplementary books supporting the school at home	11.41	
Motivation about reading skills	9.33	
Bullying experience of the student	7.40	
Reading fluency	6.33	iii iii
Sense of belonging to the school	5.77	
Competence perception	4.02	
Attitude towards school	3.33	
Competition power	3.14	
Self-efficacy	1.86	
Presence of poetry books at home	1.76	
Competition environment at school	1.61	
Cooperation perception at school	1.50	
Reading frequency	1.23	
Teacher support	1.18	
Gender	1.18	
Anxiety about reading skills	1.00	
Having his/her own room at home	0.91	
Presence of art, music, design books at home	0.50	
Presence of a dictionary at home	0.21	

When Table 4 is examined, it is seen that the most significant predictor affecting the predicted variable is the variable "number of books at home," with 100 points. Other variables that have a significant effect on reading

skills are the presence of a classical artifact at home, the difficulty perception of the student, the educational status of the father, the education level of the mother, the pleasure of reading, and the presence of school-supplied books at home. It can be said that other variables in the model are not highly effective on the reading skills variable. For the MARS model, firstly, the maximum number of basic functions must be determined based on the Generalized Cross Validation (GCV) value. The lowest GCV value obtained expresses the number of basic functions to start with to get the best model. The number of basic functions represented by the lowest GCV value was obtained as 73, and the MARS model with 73 basic functions was established. The forward-looking phase started with 0 basic functions and became the most complex when it reached 48 basic functions. As it can be seen in Table 5, the most suitable model, which is the final model with 35 basic models, has been composed, by removing the basic functions that do not contribute to the model by pruning in the forward step phase.

	Basic Function	Coefficient	Variable	Sign	Node Point
	0	0.35615			
1	1	0.23569	Number of books at home	+	SubSet1
2	3	1.35528	Perception of difficulty	+	-0.52400
3	5	0.14072	Motivation about reading skills	+	-0.59540
4	6	0.07957	Motivation about reading skills	-	-0.59540
5	7	-0.05515	Father's educational status	+	SubSet1
6	9	-0.07931	Reading pleasure	+	-0.17957
7	11	0.09539	Presence of classical artefacts at home	+	SubSet1
8	13	0.12931	Mother's educational status	+	SubSet1
9	15	1.75482	Bullying experience of the student	+	0.29070
10	17	0.61480	Attitude towards school	+	-1.16640
11	19	-0.09828	Presence of supplementary books supporting the	; +	SubSet1
12	21	0.05307	Competition environment at school	-	0.60120
12	21	-0.03337	Number of books at home	+	0.09120 SubSot?
13	25	-0.07147	Bullying experience of the student	+ +	1 44540
14	23	-0.22140	Competition nower	Ŧ	1.44540
15	20	0.02327	Eather's educational status	-	1.10110 SubSat2
10	29	-0.07100	Mother's educational status	+	SubSet2
17	31	0.07427	Cooperation perception at school	+	0.21100
10	33	0.02047	Cooperation perception at school	Ŧ	-0.21190
19	34	0.04/17	Difficulty perception	-	-0.21190
20	33	-0.14/38	Difficulty perception Deading fraguency	+	0.70070
21	37 40	-0.00400	Teacher support	Ŧ	0.60421
22	40	0.10255	Dresence of postry books at home	-	-0.09421 SubSet1
23	41	-0.04144	Salf affiancy	+	0.26168
24	43	-0.55055	Self efficacy	+	-0.20108
23	47	0.15797	Self efficacy	+	-0.00518
20	49 51	0.24270	Difficulty perception	+	0.08/0/
27	52	-2.03339	Difficulty perception	+	-0.03110
20	55 57	1.40/33	Attitude towards school	+	-0.09490
29	50	-2.02000	Attitude towards school	+	-0.70230
50 21	59	1.70827	Attitude towards school	+	-0.01980
22	01 (2	-0.23024	Attitude towards school	+	-2.07580
32 22	03 65	0.23333	Motivation about reading skills	+	0.94904
23 24	03 67	-0.14204	A priotivation about reading skills	+	0.1/082
34 25	07	0.01592	Anxiety about reading skills	+	-1.02913
33	12	-1.30139	Builying experience of the student	+	0.23080

Table 5. Final Model

In the final model, the node values were composed by each predictor variable independently from other variables, and the model coefficients that give their contribution to the regression equation as a result of multiplication with the basic function, the directions of their slopes, and the information showing which variables are distributed to the basic functions are included. The multiplication of the 35 basic functions used in creating the most suitable model with the model coefficients composed the regression equation in Table 6.

Table 6. Regression Equation for the Most Suitable Model

Y = 0.356151 + 0.235689 * BF1 + 1.35528 * BF3 + 0.140716 * BF5
+ 0.0795665 * BF6 - 0.0551473 * BF7 - 0.0793062 * BF9
+ 0.09539 * BF11 + 0.12931 * BF13 + 1.75482 * BF15
+ 0.614802 * BF17 - 0.0982762 * BF19 - 0.0539656 * BF21
- 0.0714741 * BF23 - 0.221403 * BF25 + 0.0232724 * BF28
- 0.0710607 * BF29 + 0.0742705 * BF31 + 0.0264696 * BF33
+ 0.0471711 * BF34 - 0.147377 * BF35 - 0.0640643 * BF37
+ 0.102527 * BF40 - 0.0414432 * BF41 - 0.356529 * BF45
+ 0.137969 * BF47 + 0.242702 * BF49 - 2.65539 * BF51
+ 1.46755 * BF53 - 2.0206 * BF57 + 1.70827 * BF59
- 0.236242 * BF61 + 0.253551 * BF63 - 0.142644 * BF65
+ 0.0159187 * BF67 - 1.56159 * BF72;

In Table 6, the equation starts with a constant value and then the result of the sum of the multiplication of each basic function with the coefficients in Table 5, so the regression equation for reading skills was obtained. The order of the predictor variables represented by the basic functions in this equation according to their significance levels is given in Table 7.

Table 7. Significance levels of variables according to the MARS method

Predictor Variables	Score	
Number of books at home	100.00	
Difficulty perception	71.91	
Motivation about reading skills	70.91	
Father's educational status	52.49	
Reading pleasure	48.13	
Bullying experience of the student	46.60	
Mother's educational status	45.79	
Attitude towards school	43.19	
Presence of classical artefacts at home	38.69	
Presence of supplementary books supporting the	30.37	
school at home		
Competition environment at school	24.34	
Competition power	16.86	
Cooperation perception at school	15.05	
Reading frequency	14.70	
Self-efficacy	14.53	
Presence of poetry books at home	14.25	
Anxiety about reading skills	8.76	
Teacher support	8.16	
Competence perception	0.00	
Sense of belonging to the school	0.00	
Having his/her own room at home	0.00	
Reading fluency	0.00	
Presence of art, music, design books at home	0.00	
Presence of a dictionary at home	0.00	
Gender	0.00	

When Table 7 is examined, it is seen that the most significant predictor affecting the predicted variable in the MARS method is "the number of books at home," with 100 points, similar to the result of the RF method. Other variables that have a significant effect on reading skills are "the presence of classical artifacts at home", the student's perception of difficulty, motivation for reading skills, the father's education level, reading pleasure, the student's bullying experience the mother's education status, attitude towards school, the presence of classical artifacts, presence of supplementary books supporting the school at home. Competition at school, competitiveness, perception of cooperation at school, frequency of reading, self-efficacy, and presence of poetry books at home. On the other hand; it can be said that the other variables in the model have little or no effect on reading skills variable.

The performance of students who were classified as successful or failed in terms of reading skills in PISA 2018 when assigning them to these categories with the MARS data mining method is presented in Table 8.

Predicted Value				
		Unsuccessful	Successful	Total Number of Students
Real Value	Unsuccessful	2150	899	3049
	Successful	667	1997	2664
	Total Number of Students	2817	2896	5713

Table 8. Classification Table composed for the MARS method

The performance of students who were classified as successful or failed in terms of reading skills in PISA 2018 when assigning them to these categories with the RF data mining method is presented in Table 9.

Table 9. Classification Table composed according to the RF method

Predicted Value				
		Unsuccessful	Successful	Total Number of Students
Real Value	Unsuccessful	1952	1097	3049
	Successful	601	2063	2664
	Total Number of Students	2553	3160	5713

In the study, to compare the estimation abilities of RF and MARS methods; accuracy rate, specificity rate, sensitivity ratio, precision ratio, F1 statistic values, and AUC values of the ROC curve were used. In the final section of the study, performance indicators of the RF and MARS methods in terms of accurate estimation are given in Table 10.

Table 10. Performance of RF and MARS Methods

Performance Criteria	MARS	RF	
Correct classification rate	% 72.59	% 70.28	
Specificity rate	% 74.96	% 77.44	
Sensitivity rate	% 70.51	% 64.02	
Precision rate	% 76.32	% 76.46	
F1-Statistics	% 73.30	% 69.69	
Area Under ROC Curve (AUC)	% 79.80	% 78.29	

When Table 10 is examined, it is seen that the MARS method performs better than the RF method in terms of correct classification rate, sensitivity rate, F1 statistics, and AUC values, and the RF method performs better than the MARS method in terms of specificity and precision rate.

Discussion

In the current study, the variables that were considered to be related to the reading skills of a 15-year-old student in the Turkish language field in the PISA 2018 application were examined through MARS and RF data mining methods, and the classification performances and prediction capacities of both methods were compared. As a result of the analysis, it has been seen that the MARS method gives better results than the RF method in terms of performance criteria. Therefore, the variables that were considered important by the above-mentioned method are discussed in this section by taking two dimensions into account.

In the first dimension, MARS and RF data mining methods were compared in terms of their classification performances. The RF method gives better results in terms of specificity and certainty rate; however, the MARS method performs better in terms of accurate classification and sensitivity rates, F1 score, and AUC value. Likewise, et al. (2012) reported that the RF method performed better in terms of Kappa coefficient and specificity rate, but, added that the MARS method gave better results in terms of sensitivity criteria. Yao, Yang, and Zhan (2011) stated that the MARS method performed better in terms of accuracy and sensitivity, and the RF method was more successful in terms of specificity. Chen et al. (2018) and Golkarian et al. (2018) noted that the MARS method performed to the RF method, although Munkhdalai et al. (2019) and Østergård et al. (2018) stated that the MARS method was more successful in terms of accurate classification rate compared to the RF method. On the contrary, Lawrence and Moran (2015) and Shirzad and Safari (2019) reported that the RF method performed better in terms of accurate classification rate; Arabameri et al. (2018) and

Youssef and Pourghasemi (2021) noted that the RF method gave better results in terms of AUC value compared to the MARS method. Similarly, Kundu et al. (2021) stated in their study that the RF method showed better classification performance compared to the MARS method in terms of accuracy, specificity, sensitivity, and precision rate.

In the second dimension, both methods have revealed that the quantity of books at home was the greatest predictor variable that had a significant effect on reading skills, according to the importance level in the mentioned study, using both methodologies. When the literature is examined, many studies show that the number of books in the house has an effect on reading skills (Chiu & Mc-Bride Chang, 2006; Urfalı Dadandı et al., 2018; Gündüver & Gökdaş, 2011; Kahraman & Çelik, 2017; Karatekin et al., 2012; Kurnaz &Yıldız, 2015; Kutlu et al., 2011; Türkan et al., 2015).

According to the MARS method, the variable that has a significant effect in the second place in terms of importance is the perception of difficulty (Fulmer & Tulis, 2013; Işık, 2016; Xu, 1991). It is stated that the perception of difficulty has a positive effect on success (Işık, 2016). Studies show that high-level perceptions of difficulty may produce less positive effects or negative effects such as anxiety and anger (Acee et al., 2010; Efklides and Petkaki, 2005; Fulmer and Tulis, 2013; Pekrun et al., 2002).

According to the MARS method, other predictive variables that are effective on reading skills according to their importance are the variables of motivation for reading skills and the father's education level. It is evident from many studies that the motivation variable has a positive effect on student achievement. (Aksu & Güzeller, 2016; Güre et al., 2020; İnal & Turabik, 2017) Some studies state that there is a direct relationship between motivation and student achievement (Bayraktar, 2015; Mendi, 2009; Uzun & Keleş, 2010). Therefore, it is important to carry out studies to increase the motivation of students. On the other hand, another variable considered significant in our study is the father's education level. In parallel with the findings of our study, Anıl (2009) also found that a father's education level is more effective than a mother's education level in determining the success of students.

According to the MARS method, other predictive variables that are effective on reading skills based on their importance include the variables of reading pleasure and the student's bullying experience. It is known that there is a positive relationship between reading pleasure and achievement (Chiu & Mc-BrideChang, 2006; Smith et al., 2011). Another variable that is considered significant in the present study is the student's experience with bullying. In parallel with the results of our study; in the study conducted by Sevgin (2020), it was seen that the bullying variable was significant in predicting science achievement. But; in the study conducted by Acıkgöz (2017), no significant difference was found between bullying and academic achievement. Teachers should pay special attention to their students who are faced with bullying, and take approaches that make them feel valued. The variables of maternal education level and attitude towards school are two further predictive variables that the MARS approach finds significant in the predicted variable. In many studies; it is shown that the education levels of the students' mothers are related to the success of the students (Anıl, 2009; Güre et al., 2020; Karabay et al., 2015; Savaş et al., 2010). In this context, it can be considered significant that parents take part in educational activities within the scope of lifelong learning in terms of being a role model for the student. On the other hand, another variable considered significant in the study is the students' attitude toward school. It is known that student attitudes affect academic achievement. It has been observed that if the student's attitude towards school is positive, the student is successful, if it is negative, the student is unsuccessful (Açıkgöz, 2017).

Other variables that have a major effect on reading skills, according to the MARS method, include the presence of classical works at home and the existence of school-aided resources at home, in order of importance. Many studies support our results (Erdoğan & Acar Güvendir, 2019; Kaya, 2017). Arıcan and Yılmaz (2010) concluded that reading classical works partially increases the reading habit; however, in the study conducted by Okur and Arı (2013), the effect of reading a classical book on whether the student gains or develops a reading habit could not be determined with certainty. On the other hand, another variable that is considered significant in the present study is the variable "presence of resources supporting the school. In parallel with the results of the study, in the study of Erdoğan and Acar Güvendir (2019), it is stated that students' having supplementary resources can contribute to the improvement of their reading skills. Unlike the study results, in the study conducted by Urfalı Dadandı et al. (2018), it was found that supplementary sources do not have a significant effect on reading skills. Taş and Minaz (2018) stated that students prefer supplementary resources more because they find them simple and concise, have more activities, and attract attention. Therefore, textbooks should be supported by supplementary resources.

Other variables that the MARS method considers important for reading skills in the present study are the variables of competition environment and competitiveness in school, in order of importance. It should be seen that activities

that allow students to compete with each other are significant. Students with high competitive power have high academic success (Bing, 1999; Frymier & Houser, 2000; Shimotsu-Dariol et al., 2012).

According to the MARS method, other important predictive variables on reading skills include the perception of cooperation at school and the frequency of reading, in order of importance. It should be considered significant to organize activities in the school environment where students can collaborate. On the other hand, another variable that seems significant is reading frequency. Studies have reported that reading habits have a positive effect on academic achievement (McQuillan & Au, 2011; Kurulgan & Çekerol, 2008; Tercanhoğlu, 2001).

Other predictive variables that the MARS method finds important are self-efficacy and the presence of poetry books at home, in order of importance. Self-efficacy perception shows students' belief that quality results will be achieved when an effort is made. Many studies show a significant relationship between self-efficacy perception and achievement (Chang & Bangsri, 2020; Maier & Curtin 2005). On the other hand, the other variable that seems significant is "having poetry books at home". It is stated that having poetry books at home increases reading skills (Erdoğan & Acar Güvendir, 2019; Kaya, 2017).

Finally, according to the MARS method, the factors of anxiety and teacher support for reading skills are, in order of significance, predictive variables that have a significant effect on the predicted variable. It is known that there are studies reviewing students' anxiety levels in the literature (Aksu & Güzeller, 2016; İnal & Turabik, 2017; Yücel & Koç, 2011). On the other hand; another variable that is considered significant is the teacher support variable. In parallel with our study results, in the study of Chang and Bangsri (2020), it is stated that teacher support indirectly affects success. When students feel the support of teachers in the classroom, they think they are cared for and feel valued, which will increase their commitment to the school and the teacher, and this will bring success with it.

Conclusion

Within the scope of this research, MARS and RF data mining methods were discussed in order to examine the data obtained by large-scale tests, and they were recommended as alternatives for use in the field of education. In this study, MARS from the family of nonlinear regression methods under the umbrella of data mining and the RF analysis method using the Bagging algorithm from Ensemble methods were used together. Therefore, it is valuable in terms of demonstrating the use of data mining approaches in the educational research process. Unlike the MARS data mining method, the RF data mining method is easier to access. For the MARS method, there are paid programs such as STATISTICA, SAS, SPM, and free package programs such as R (Earth Package), while many paid programs such as SPSS Modeler, STATISTICA, SAS, SPM, and free package programs such as Orange, WEKA, and R (Random Forests package) are available for the RF method.

Recommendations

In addition, new studies may be considered on different samples for the generalizability of the obtained findings. Again, different from RF using the Bagging algorithm, it is also recommended to use data mining methods using the Boosting algorithm, such as Boosted Regression Trees (BRT), Multiple Additive Regression trees (MART), or Additive Boosting (Adaboost), in the process of educational research.

Author (s) Contribution Rate

The authors contributed equally.

Conflicts of Interest

There is no conflict of interest for individuals or institutions in this research.

Ethical Approval

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Teacher Self-Efficacy, Innovativeness, and Preparation to Teach Cross-Curriculum Skills

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Teacher Self-Efficacy, Innovativeness, and Preparation to Teach Cross-Curriculum Skills

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Abstract

Teacher self-efficacy (TSE) is related to teachers' job satisfaction, retention, motivation to improve, and work-related stress. Using data from the 2018 Teaching and Learning International Survey (TALIS), we investigated the impact of an innovative campus culture and preparation for teaching cross-curriculum skills on TSE. Data indicated that working at innovative campuses had small effects on TSE in classroom management ($\beta = .12$), instruction ($\beta = .06$), and student engagement ($\beta = .17$). Teachers' preparation to teach cross-curriculum skills had small to medium effects on TSE in classroom management ($\beta = .20$), instruction ($\beta = .34$), and student engagement ($\beta = .30$).

Keywords: Teacher self-efficacy, Cross-curriculum, Innovative school, Innovative campus, Teacher preparation, Educational psychology

Teacher Self-Efficacy, Innovativeness, and Preparation to Teach Cross-curriculum Skills

Teacher self-efficacy affects the quality of both teacher and student experiences. Teacher self-efficacy (TSE) reflects the beliefs teachers have about their ability to effectively handle tasks, obligations, and challenges related to teaching, and influences academic outcomes. TSE is related to teachers' retention, jobsatisfaction, lower levels of work-related stress and motivation to learn and improve (Bandura, 1982; 2012; Klassen & Chiu, 2010; Marjolein & Helma, 2016). Understanding the factors that affect TSE is important for recruiting, training, and retaining effective teachers.

Bandura (1982) suggested that people with high self-efficacy are likely to persist and devote more effort to a task when it isperceived as difficult. This means that teachers with higher self-efficacy are more resilient in the face of changes or challenges and may even be able to support one another on teaching teams. Collective self-efficacy is derived from the social and organizational contexts of an individual's self-efficacy (Bandura, 2000; Viel-Ruma et al., 2010; Zaccaro, et al., 1995). Teachers working in a district or school context in which the individual self-efficacy of their peers is high may experience a boost in their own self-efficacy as they draw on the collective strength of the self-efficacy of others around them. A strong sense of individual efficacy that impacts changes in society or in the local community is directly related to perceived collective efficacy (Bandura, 2000). Removing barriers to positive collective self-efficacy is key to overcoming external obstacles (Bandura, 1982; 2000).

Teacher Self-Efficacy

Self-efficacy is the belief that individuals hold about their ability to engage in certain behaviors. People with high self-efficacy are more likely to be open to new experiences, conscientious, and embrace prosocial behaviors (Bandura, 2012). Teacher self-efficacy is defined as self-efficacy related to the tasks, skills, and challenges involved in the teaching profession and may impact motivation and affective commitment to remain in a position (Canrinus et al., 2012). Teachers from the same school are likely to have similar TSE, as a clustering effect appears to align their TSE with collective teacher self-efficacy (CTSE) (Caprara, et al., 2006; Skaalvik & Skaalvik, 2007). Collective self-efficacy may draw an individual's sense of self-efficacy upward or downward in that context. Teachers' job satisfaction is positively influenced by TSE in both instructional strategies and classroom management, suggesting that improving TSE may help improve overall job satisfaction (Klassen & Chiu, 2010).

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Professional development may also improve TSE; however, this is not guaranteed. Yoo (2016) found that teachers may either interpret the acquisition of knowledge as strengthening it or revealing flaws that were previously unknown; therefore, the frame of reference of the individual may impact the lens through which they view themselves.

According to a meta-analysis of Teaching and Learning International Survey (TALIS) related reports, TSE has a significant positive effect on job satisfaction, regardless of country, continent, or culture (Kasalak & Dağyar, 2020; Klassen & Chiu, 2010; Vieluf, et al., 2013). This is a universally impactful force in improving teacher success, which may also affect student success. A focus on TSE during in-service programmes is positively related to the improved quality of instructional support used in the classroom (Marjolein & Helma, 2016). Some studies have found mixed results about the relationship between TSE and student achievement, citing indirect impacts on student achievement through motivation and that teaching high-performing classes can positively impact TSE (Fackler & Malmberg, 2016; Marjolein & Helma, 2016).

Determining the variables that most strongly affect the TSE is somewhat more complicated. Some data indicate that positive emotions toward students help overcome the negative emotions experienced by teachers, thereby raising TSE in net effect (Buonomo et al., 2019). For example, if a teacher is experiencing difficulties but expresses a positive feeling toward their students, their self-efficacy is resistant to the impact of the difficulty. Teacher mental health is positively correlated with both individual and collective self-efficacy, as well as with emotional exhaustion, while depersonalization and depression are negatively correlated with both individual and collective self-efficacy, as well as job satisfaction (Capone & Petrillo, 2020). Teachers who lack support and resources have lower persistence and TSE, which may lead to a greater likelihood of leaving (Grant, 2006). In one study, novice teachers who believed that their teaching team or campus exhibited a shared collective responsibility for student success had a higher TSE and, therefore, a decreased intention to leave the profession (De Neve & Devos, 2017). Time spent in the profession is related to increases in individual TSE, and primary school teachers tend to have a slightly higher TSE for student engagement and classroom management than secondary school teachers, although there are no differences between primary and secondary school teachers in TSE for instructional strategies (George et al., 2018). The positive impact of time is limited; research reveals that after an average of 23 years in the profession, the TSE begins to decline (Klassen & Chiu, 2010; Krammer et al., 2018). CTSE is distinguishable from individual TSE; in contrast, the impact of time is negatively correlated with time and CTSE (Skaalvik & Skaalvik, 2007).

Teachers who experienced greater workload stress but not classroom stress had an unexpectedly higher TSE (Klaeijsen et al., 2018; Klassen & Chiu, 2010). This suggests that although teachers may take on stress from additional work-related loads—such as accepting the burden of additional duties, acting as sponsors for student groups, or supporting co-workers—they may actually feel more efficacious for having taken on additional work. Other factors that can positively impact TSE are student involvement in teacher evaluations, cooperation among teachers, and the perception of satisfactory classroom management techniques (Egido Gálvez et al., 2018). Egido Gálvez et al. (2018) also found that teachers who lacked professional development in an area may find that their TSE was negatively impacted by the need for professional development. In other words, when teachers realize they are lacking in a certain set of skills, they begin to feel less efficacious as a result of that awareness. Professional development, especially development based on current standards and immediately relevant to the classroom, is positively correlated with TSE (Marjolein & Helma, 2016; Yoo, 2016). Students expressed that the experience of effective teacher strategies impacted teachers' self-efficacy in a reciprocal relationship (Marjolein & Helma, 2016). When students talk about or share information about a teacher's teaching strategies positively, the teacher begins to feel more efficacious. Student achievement also affects TSE, and teachers teaching in highachieving classrooms are more likely to have a higher TSE than their peers (Caprara et al., 2006). Principals who are supportive and deemed approachable by teachers also positively impact TSE (Aldridge & Fraser, 2016). In short, pleasant experiences that teachers have in the classroom, among their peers, and with their leadership may lead to greater TSE. Given that the research mentioned above indicates positive impacts from cooperation among teachers, professional development, positive student responses and achievement, and principal support, it becomes clear that the overall organizational climate of the school matters to the development of a healthy TSE, both individually and collectively.

Innovative Campuses

The literature in both psychology and management refers to innovative behaviors and creativity as the same or related constructs (Hsu et al., 2011; Ng & Lucianetti, 2015; Somech & Drach-Zahavy, 2013; Thurlings et al., 2015). Creativity leads to creative behaviors, which, when implemented in the workplace, result in innovation;

therefore, creative and innovative labels are largely interchangeable. Although a creative personality is an individual construct, acohesive team can develop a collective personality that conforms to individual personalities (Dampérat et al., 2016; Grosser et al., 2017). The team acts as a unit that draws collectively on the individual personalities of team members as needed; thus, individuals can experience higher creative self-efficacy as members of a cohesive group (Dampérat et al., 2016; Somech & Drach-Zahavy, 2013). Park et al. (2021) found that the relationship between collective creative self-efficacy and performance has an inverted U-shape, suggesting that the greatest innovative output does not necessarily come from a collection of people with the highest individual self-efficacy. There may be an optimal level of individual efficacy at which collective efficacy becomes the most productive.

When teachers implement innovations, they not only teach new strategies but also model the process of innovation at the same time (Klaeijsen et al., 2018). While a change agent in an organization affects teams and organizations, teachers affect their teams, schools, countless children, and communities. Parry (2018) points out that developing a culture of teacher-led innovation is the best way to transform both the schools and communities in which they reside. Teachers' creativity, when directed toward productive change, is a powerful tool. Be cause of this potential, it is important to examine the relationship between TSE, the perception of innovative behavior, and the contexts in which these behaviors arise.

Teacher innovation research has demonstrated that factors such as teacher experience, skills, and teaching philosophy can impact the rate of teacher integration of novel technologies (Mueller et al., 2008). Supervisors or organizational expectations may have both positive and negative impacts, depending on the ability of the individual to meet or exceed those expectations (Chang et al., 2011; Pugh & Zhao, 2003; Tierney & Farmer, 2011). Goal interdependence, when combined with self-efficacy, has a positive effect on innovative behaviors (Thurlings et al., 2015); however, individuals with collectivist grounding may be concerned that increasing innovative behaviors could negatively impact social equilibrium (Ng & Lucianetti, 2016). Occupational self-efficacy was found to be positively correlated to the intrinsic motivation in teachers as well as with innovative behavior among teachers (Klaeijsen et al., 2018). Educational innovations on the rise include increased emphasis on the teaching and development of cross-curriculum skills in K-12 schools as programs such as the International Baccalaureate and STEM Problem-Based Learning models have become more popular. As these models proliferate, it becomes crucial to understand the impact of innovation uptake and implementation on teachers and scholars.

Cross-Curriculum Skills

Cross-curriculum skills, also called 21st Century skills, are cognitive skills that translate across all content areas and can be applied not only in the classroom but also later in life. There are many models and frameworks for identifying these skills, but most agree that problem-solving, collaboration, interpersonal, creativity, information literacy, and production skills are key cross-curriculum skills for young people today (Geisinger, 2016). Their importance grows as the speed of innovation continues to make existing jobs obsolete, and new areas of expertise arise with increasing frequency. Training students in the age of technology requires them to be adept at skills that will allow them to create their own jobs and navigate a rapidly changing world. Efforts to prepare te achers to implement change and teach these skills in the new age of technology have proven difficult, and little progress toward fundamental changes in school systems is evident (Erstad, et al, 2015). Some evidence points to the need for teachers to first develop their own cross-curriculum skills before they can effectively teach them to others (Karatas & Arpaci, 2021; Teo et al., 2021). Additionally, technical support and continued professional development contribute to teachers' successful implementation of innovative technologies and their ability to support students' skill development (Zheng, et al., 2016). While new-to-professional teachers are often prepared using the latest teaching methods for cross-curriculum skills, in-service teachers may have fewer opportunities to obtain and test strategies for innovative professional development.

In a systematic review of studies of pre-service education center programming on 21st century skills, Teo et al. (2021) identified three crucial missing pieces in teacher preparation programs: identifying the needs of teachers ahead of designing programs, developing theoretical frameworks and tools, and finding the crucial balance between keeping up with technological change and building sustainable programs. Many pre-service teachers have misconceptions about what these skills are, believing that 21st Century skills, or cross-curriculum skills, reference largely technology-related or digital literacy skills rather than including the full scope of problem-solving, critical thinking, and creativity skills (Karakoyun & Lindberg, 2020). In some teacher training programs, a blended learning approach was found to improve pre-service teachers' cross-curriculum skills as well as their self-efficacy and helped to increase their potential for becoming lifelong learners (Sentürk, 2021). Overcoming

misperceptions and developing a shared vocabulary around cross-curriculum skills is the first step toward improving the successful replication of these skills in the classroom.

From the research already discussed, we understand that there are a variety of organizational factors that may impact the TSE. These include, but are not limited to, the relative supportiveness of school leadership, teachers' own experiences in the classroom, opportunities for professional development, and innovative structures and atmosphere. Figure 1 presents a theoretical model that includes these organizational factors.



Figure 1. Theoretical model of innovation and teacher self-efficacy

Factors broadly defined as the school environment, teacher experiences, and professional development opportunities work together to support healthy teacher self-efficacy. As each variable increases in strength, teachers'self-efficacy also increases. Conversely, if any of these is underperforming or missing, the potential for a healthy TSE diminishes. The relative strength of TSE for individuals may also affect the CTSE of campus teams. Finding a way to achieve an optimal individual TSE for teachers so that the campus can achieve a strong CTSE for the campus as a whole should be an organizational goal. As each variable increases or decreases, the TSE of an individual also increases. Experience is defined as an individual variable known to affect TSE, such as the reciprocal relationship between teachers and students. School environment includes the innovativeness of the campus and the relative supportiveness of school leadership.

Purpose and Rationale

Considering the potential relationships identified in previous studies of occupational self-efficacy and innovation, further research is required to determine how these relationships interact within the teaching profession. TSE tends to predict higher engagement and job satisfaction, lower levels of burnout, and lower intention to leave the teaching profession (Avanzi et al., 2013; Brouwers & Tomic, 2000; Collie et al., 2012; Klassen & Chiu, 2010; Klassen et al., 2012; Saricam & Sakiz, 2014; Skaalvik & Skaalvik, 2007; 2010; 2011; 2014). Concurrently, contemporary knowledge economies feed an increasing demand for cross-curriculum skills, specifically creative thinking, critical thinking, and problem-solving (Dewett & Gruys, 2007; Mushynska & Kniazian, 2019; Parry, 2018; Schroeder et al., 2013). Moreover, teacher preparation to utilize and teach these cross-curriculum skills is needed in pre-service and continuing professional education (Hocenski et al., 2019). As technology and innovative cross-curriculum programs continue to grow in popularity, teasing out such relationships may have explanatory and predictive power for both researchers and practitioners.

Using Bandura's (1982) framework, this study examined the relationships between two organizational variables and teacher self-efficacy. The first predictor was teachers' perception of the innovative nature of their schools. Specifically, are teachers at school open to change, looking for new ways to teach, and generally supportive of innovative efforts? The second predictor variable was teachers' perception of how well prepared they believed they were to teach cross-curriculum skills such as creative thinking, critical thinking, and problem-solving. Thus, the following hypotheses were tested:

- 1) Working at an innovative school has a positive effect on teacher self-efficacy.
- 2) Preparation to teach cross-curriculum skills (e.g., creative thinking, critical thinking, and problem solving) has a positive effect on teacher self-efficacy.

Method

For this descriptive study of United States teachers, we analyzed secondary data from the 2018 Teaching and Learning International Survey (TALIS) implemented by the Organization for Economic Co-operation and Development (OECD, OECD.org, 2020). The psychometric data on the TALIS 2018 survey scales were originally reported in the *TALIS 2018 Technical Report* (OECD, 2019).

Participants

The participants were teachers (N=2,560) in the United States. Sixty-seven percent (n=1,717) were female, 32.7% (n=837) were male, and 0.3% (n=7) were not disclosed. The teachers had completed years of experience ranging from 0 to 50 years, with a mean of 13.98 years (SD=9.42). Most teachers (98.1%) had a bachelor's degree, and 1.9% had a master's degree.

Measures

The TALIS 2018 Teacher Questionnaire included 58 items, some of which required multiple responses. In this study, we used a portion of the TALIS items described below.

Teacher Self-Efficacy Scale

The TSE Scale (OECD, 2019) measures overall TSE with a three-factor structure; each factor includes four items. In this sample of teachers, the scale had a stratified Cronbach's alpha of 0.911. Each factor also indicted high levels of reliability: (a) classroom management, $\omega = 0.845$; (b) instruction, $\omega = 0.821$; and (c) student engagement, $\omega = 0.801$. Individual factor loadings exceeded 0.500 for all 12 items.

$Team \, Innovativeness \, Scale$

The Team Innovativeness Scale (OECD, 2019) measures teachers' perceptions of how their campus team (a) developed new ideas for teaching and learning, (b) was open to change, (c) searched for new ways to solve problems, and (d) provided practical support for each other in the application of new ideas. The four-item scale demonstrated high internal consistency, $\omega = 0.889$, and individual item loadings greater than .700 on all four items. The model fit indices are presented in Table 1. In this scale, it is important to note that team innovativeness was a measurement of the campus-wide teacher team, and not smaller sections of teams such as vertical teams, content teams, or teacher PLC groups.

Preparation to Teach Cross-curriculum Skills

In the TALIS data collection, teachers were asked about the elements of their pre-service programs and how prepared they believed they were to implement those elements. Teachers responded to a single item regarding their preparation for teaching cross-curriculum skills. Specifically, the item asked "how prepared do you currently feel to teach cross-curriculum skills (such as creative thinking, critical thinking, and problem-solving)?". Responses were provided on a Likert scale (1-not at all prepared, 2-somewhat prepared, 3-well prepared, 4-very well prepared).

Analysis

Previous research has indicated that structural equation modelling (SEM) is the suggested method for examining TALIS TSE data (Scherer et al., 2016); therefore, the research questions were addressed using SEM with sample

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and replicate weights. Both models were estimated in Mplus (v.8.7; Muthén & Muthén, 2017) using maximum likelihood with robust standard errors, because this estimator corrects for non-normality and can be used with replicate weights (Stapleton, 2008). The fit results were reported for the model estimated with sample weights; fit statistics were not available for models using replicate weights (Muthén & Muthén, 2017). The Comparative Fit Index (CFI) and the Tucker Lewis Index compare the current model to a baseline, and values exceeding .95 for either index are interpreted as good model fit (Hu & Bentler, 1999). In addition, model fit interpretations typically include indicators such as the Root Mean Square Error of Approximation (RMSEA) and Standardized Room Mean Square Residual (SRMR). RMSEA provides an indication of model parsimony with values less than .05, interpreted as a lack of bad fit given the number of parameters. SRMR provides information about the correlation residual with values below .08, indicating a good model fit (Hu & Bentler, 1999; Kenny & McCoach, 2003). The last indicator of fit, a non-significant chi square, is difficult to achieve with large samples because of limitations in the way the chi square is calculated (Schumacker & Lomax, 2004), but a useful measure of fit can be calculated by using the chi square value divided by the degrees of freedom. This value should be less than five. No modification indices will be used, and residuals will not be correlated; correlated residuals may improve model fit but should only be used if the theoretical framework supports them. Parameter estimates are reported for the model using sample and replicate weights because standard errors on the sample and replicate weight models are considered the most accurate (Muthén & Muthén, 2017).

Results

The TSE and team innovation model was estimated twice with sample weights to provide fit statistics and once with sample and replicate weights to provide parameter estimates with correct standard errors. For the sample weight model, the multiple fit statistics indicated that the model fitted the data. While the chi square value is significant, $\chi^2(111) = 464.61$, p < .001, models with large sample sizes often return a significant chi square even when the model demonstrates adequate fit by other standards (Schumacker & Lomax, 2004). The final sample-weighted model containing all factors resulted in CFI = .95, TLI = .94, RMSEA = 0.045, 95% CI [0.042;0.048], and SRMR = .03. All fit statistics indicated the global fit of the model to the data and suggested model parsimony. Dividing the chi-square value by the degrees of freedom yields a value of 4.18, which is below the acceptable value of five. The correlation matrix for all the variables is presented in Table 1, and the general descriptive data are presented in Table 2. Examination of the loadings also revealed no evidence of local strain in the final model.

<i>n</i> =2,519	(1)	(2)	(3)
(1) Self-Efficacy: Classroom Management	-		
(2) Self-Efficacy: Instruction	.495**	-	
(3) Self-Efficacy: Student Engagement	.506**	.595**	-
(4) Team Innovativeness	.116**	.091**	.177**

Table 1. Correlation Matrix

N=2,425)	Mean (SD)	Min	Max
eacher Self Efficacy Total	12.83 (1.92)	4.00	16.00
SE: Classroom Management	13.13 (2.36)	4.00	16.00
SE: Instruction	13.08 (2.15)	4.00	16.00
SE: Student Engagement	12.26 (2.48)	4.00	16.00
eam Innovativeness	11.78 (2.38)	4.00	16.00
repared to Teach Cross-Curricular Skills	2.78 (0.87)	1.00	4.00

Table 2. Descriptive Data

Self-Efficacy, Cross-curriculum Preparation, and Team Innovation

The structural part of the model (see Figure 2) addressed both hypotheses about the relationships between teacher preparation to teach cross-curriculum skills and campus innovation and the three categories of TSE. Standardized estimates are reported below, and Table 3 in the appendix contains both standardized and unstandardized estimates. Standardized estimates can be interpreted as effect sizes using a scale similar to Pearson's r (*i.e.*, small =.1, medium = .3, and large =.5; (Field, 2017; Geiser, 2013)), which allows readers to judge the strength or magnitude of relationships between variables within the same model.



Figure 2. Conceptual Model of potential influences on TSE, * indicates p < .001

We rejected the first null hypothesis that there is no relationship between working at an innovative school and teacher self-efficacy. Working at an innovative school was related to teacher self-efficacy; however, the effect

was small. The relationship was estimated for all three factors of teacher self-efficacy: classroom management self-efficacy ($\beta = .12, p < .001$), instructional self-efficacy ($\beta = .06$), and student engagement self-efficacy ($\beta = .17, p < .001$). When teachers perceive that they work at an innovative school, this perception tends to have a small positive effect on their teacher self-efficacy; however, the impact on instructional self-efficacy is perhaps negligible.

We also rejected the second null hypothesis, that there is no relationship between teachers' preparation to teach cross-curriculum skills and teacher self-efficacy. Feeling prepared to teach cross-curriculum skills, such as creative thinking, critical thinking, and problem solving, had a positive effect on teacher self-efficacy. Similarly, the effects were estimated for all three factors of teacher self-efficacy: classroom management self-efficacy ($\beta = .20, p < .001$), instructional self-efficacy ($\beta = .34, p < .001$), and student engagement self-efficacy ($\beta = .30, p < .001$). When teachers perceive that they are well prepared to teach cross-curriculum skills, perceived preparation yields small to medium effects on their teacher self-efficacy, with the smallest impact in the area of classroom management self-efficacy.

Discussion

Self-efficacy in general and TSE in particular tend to influence how teachers approach their work. In almost all professional circumstances, higher teacher self-efficacy is more desirable than lower self-efficacy. Thus, there is practical value in determining the factors that influence higher levels of teacher self-efficacy. Teachers with higher self-efficacy are more satisfied with their jobs, more willing to learn and grow professionally, and are better at managing work-related stress (Klassen & Chiu, 2010; Marjolein & Helma, 2016). This study tested two possible variables that might logically be related to teacher self-efficacy, and the results suggest that efforts to improve both variables may also raise the levels of teachers' self-efficacy.

Working at an innovative campus had a small positive effect on teacher self-efficacy. Self-efficacy may be influenced by the organizational environment or, at least, by teachers' perceptions of the environment (Bandura, 2000; Friedman, 2003). Friedman and Kass's (2002) conception of teacher self-efficacy includes not only teachers' personal efficacy beliefs but also teachers' beliefs about the organization and their relationships with others in the organization, which in this case is the school. The effects on self-efficacy for working at an innovative school were small but interesting in that they may support this conception of teacher self-efficacy as both personal and organizational. Similarly, Dampérat et al. (2016) and Somech and Drach-Zahavy (2013) found that individuals draw on the collective efficacy of a cohesive group to increase creative TSE. The impact of the school or fellow faculty members at TSE merits further study, in which team innovation is conceptualized in a broader category of organizational variables affecting TSE.

Conceptions of 21st Century education and the automation economy have increased an emphasis on teaching cross-curriculum skills, such as creative thinking, critical thinking, and problem-solving. These skills are cross-curriculum in that they are expected to be taught, modeled, and assessed across all disciplines of the curriculum. Some research (Author, 2016) suggests that teachers commonly misunderstand creativity and how to teach creative thinking. Similarly, teachers may have little training in teaching critical thinking or problem-solving skills (Abrami et al., 2015). Teachers who believed that they were well prepared to teach these skills tended to have a higher TSE on all three subscales.

Summary

These findings provide avenues for future research and have potential immediate practical implications. The midlevel positive predictability between cross-curriculum skills training and TSE in instruction and student engagement indicates that teachers are strengthened by preparing to teach skills that are most important to students. Indeed, even as greater emphasis has been placed on teaching cross-curriculum skills, such as creativity, problem solving, and communication, teachers still struggle to prove it in teaching in the classroom (Aldossari, 2021). As these skills are crucial to future student success, it follows that preparation for these skills and the subsequent boost in TSE that teachers receive from that preparation are key to students' actualization of these skills (DiBenedetto & Meyers, 2016).

Additionally, given previous research suggesting that principal support and approachability positively impact TSE (Aldridge & Fraser, 2016), it would be interesting to see whether other interorganizational factors may also contribute to building the individual and collective self-efficacy of campus teams. A potential avenue for future

research would be to consider whether teacher data and principals' innovative team perceptions are related, as well as whether these relationships impact TSE. Another interesting question is whether specific types of educational organizations, such as Montessori, PTech, or IB schools, which are designed to emphasize cross-curriculum skills, promote greater preparation more directly for those skills in teachers, and whether teachers in those institutions have significant differences in TSE than their peers working in traditional school environments. We plan to pursue additional research comparing the data obtained in this study to principal data from the same TALIS survey to determine the relationships between perceptions of leadership and the perceptions of the teachers themselves.

Limitations

While we were able to determine positive relationships between preparation to teach cross-curriculum skills, innovative schools, and TSE, the use of TALIS data precluded gaining an understanding of one aspect of our theoretical model. These data were not useful in determining the optimal individual TSE for the campus to achieve an optimal collective TSE or CTSE. As the relationship between CTSE and innovative output requires a delicate balance (Park et al., 2021), it is important to determine how this balance can be achieved. Future research should examine the relationship between individual and collective TSE to determine whether there is a quantifiable optimum amount of CTSE to support innovation in schools. Rather than stopping at the theoretical implications of this research, future research should examine the practical application of adjusting organizational factors to achieve and maintain an optimal CTSE to create an atmosphere in a school or district where innovative output is maximized. This requires design thinking while structuring research that will allow for testing and adjusting organizational variables to find the sweet spot for optimal CTSE.

One caution for this type of future research is that it is often difficult to adjust for many organizational variables at play. While the amount and quality of professional development are more easily addressed, it is unlikely that a researcher will be able to change the leadership style on campus or address some of the classroom issues that teachers face. It is impossible to control for all potential experiences that a teacher would have, and indeed all that a team would experience collectively. Therefore, future studies should be conducted cautiously. Perhaps research that seeks to first examine schools that are similar in organizational environments, and later different in organizational environments in order to determine what is actually impacting TSE and CTSE would be beneficial. The potential for confounding variables was high. Utilizing qualitative research methods and longitudinal studies may allow us to determine whether specific organizational and professional development variables affect the attainment of optimal TSE. Qualitative studies should focus on determining how a principal might be able to identify what it looks like when optimal CTSE is reached, and how variables might be adjusted during the course of normal practice to reach and maintain that CTSE.

In addition, it is possible that what is determined to be an optimal CTSE may itself vary depending on context. For example, the unexpected impact of the COVID 19 pandemic and the dramatic shift to online schooling for many teachers may have required a different optimal CTSE than when the school was conducting a session in its usual format. Additionally, disruptions to the school environment, such as significant leadership changes, shifts to different schooling models, or disruptions due to natural disasters, may also affect the necessary optimal CTSE. Nevertheless, the next step should be to determine what an optimal CTSE looks like and how it might be balanced by supporting an individual TSE.

In any case, the further study of teacher self-efficacy and organizational innovativeness should be examined. As we enter a new world of technological innovation, we are preparing a generation for occupations that may not yet exist. The potential of the next generation to adapt and innovate in this unknown future is tightly bound to teachers' self-efficacy and abilities. As a result of the last several years of disruption to the educational community, identifying factors that may draw teachers into the profession and encourage teacher retention has become increasingly valuable. Determining the impact of TSE and how these variables can be manipulated to create optimal CTSE and innovative output are important goals for educational research and practice.

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Authors Contribution Rate

Celeste Sodergren: Concept and design, acquisition of data, analysis and interpretation, drafting, revising, approval. Todd Kettler: Concept and design, analysis and interpretation, drafting, revising, approval. Tracey

Sulak: Concept and design, analysis and interpretation, drafting, approval. Anna Payne: Analysis and interpretation, drafting, approval.

Conflicts of Interest

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Appendix

Table 3. Standardized and unstandardized estimates from structural equation modeling

Parameter Estimate	Unstandardized	Standardized
Measurement Model Estimates		
Team Innovation		
TT3G32A- Teachers strive for new ideas	1.00	.78*
TT3G32B- Teachers open to change	1.08 (.04)	.83*
TT3G32C- Teacher look for new ways to solve problems	1.18 (.04)	.89*
TT3G32D- Teachers give each other practical support	0.95 (.05)	.72*
Class Management Self-Efficacy		
TT3G34D- Control disruptive behavior	1.00	.81*
TT3G34F- Make behavioral expectations clear	0.69 (.02)	.64*
TT3G34H- Get students to follow classroom rules	0.93 (.04)	.82*
TT3G34I- Calm a disruptive or noisy student	0.97 (.02)	.77*
Instructional Self-Efficacy		
TT3G34C- Craft good questions for students	1.00	.59*
TT3G34J- Use a variety of assessment methods	1.37 (.06)	.75*
TT3G34K- Provide alternative explanations	1.13 (.07)	.71*
TT3G34L- Vary instructional strategies	1.37 (.07)	.77*
Student Engagement Self-Efficacy		
TT3G34A- Get students to believe in self	1.00	.82*
TT3G34B- Help students value learning	1.10 (.02)	.83*
TT3G34E- Motivate students	0.94 (.03)	.72*
TT3G34G- Help students think critically	0.80 (.05)	.67*
Structural Model Estimates		
Team Innovation on TSE-Class Management	0.13 (.04)	.12*
Team Innovation on TSE-Instructional	0.04 (.02)	.06
Team Innovation on TSE-Student Engagement	0.19 (.03)	.17*
Cross-Curricular Skills on TSE-Class Management	0.12 (.02)	.20*
Cross-Curricular Skills on TSE-Instructional	0.13 (.01)	.34*
Cross-Curricular Skills on TSE-Student Engagement	0.18 (.02)	.30*
Instructional TSE with Class Management TSE	0.12 (.01)	.54*
Instructional TSE with Student Engagement TSE	0.17 (.01)	.52*
Student Engagement TSE with Class Management TSE	0.13 (.01)	.60*
Note. *p < .001		



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Attitudes Towards STEAM, Critical Thinking Disposition and Decision-Making Skills: Mediation and Gender Moderation

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Attitudes Towards STEAM, Critical Thinking Disposition and Decision-Making Skills: Mediation and Gender Moderation

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Abstract

The relationship between highly desired 21st century skills, such as students' attitudes toward STEAM, critical thinking dispositions, and decision-making abilities, and the role of gender on these associations was investigated in this study. The data was collected from 4th grade students in the 2022-2023 academic year using the typical case sampling method. "STEAM Attitude Scale", "Critical Thinking Disposition Scale" and "Decision-Making Skill Scale" were utilized. The mediation model was estimated using the whole sample, followed by multigroup analyses that employed gender as the moderation variable. The results indicated that primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills were at a high level. The mediation analysis revealed that attitudes towards STEAM had direct effect on decision-making skills, and critical thinking disposition was found to be partially mediating this association. Multigroup analyses provided evidence for the significant moderating role of gender pertaining to the specified associations in the model. The findings provide insights into the importance of developing positive attitudes towards STEAM disciplines regarding their evidential effect on critical thinking disposition and informed decision-making skills in primary schools and the necessity of attending to the role of gender in future educational interventions.

Keywords: Critical thinking disposition, Decision-making skill, STEAM, Primary school, Gender

Introduction

Changes in individual and societal needs, along with rapid global changes in science, technology, innovations, and teaching approaches, have undoubtedly affected the adaptive skills expected from the individual. Many countries have incorporated these skills into their curriculum, such as producing knowledge and using it in daily life, thinking critically, being decisive entrepreneurs, working collaboratively to solve problems, and having communication skills (e.g., Ministry of National Education [MoNE], 2018; National Research Council, 2014). Although there is no consensus on 21st century skills that globally inspire curricula, these vital skills for schooling can be listed as self-efficacy, career and life skills, cooperation and collaborative thinking, critical thinking, creative thinking, and problem solving (Beers, 2001; Lamb et al., 2017). Additionally, the widespread use of social media, along with rampant misinformation (Kyza et al., 2020), and the availability of online educational resources require students to gain and apply higher-order decision-making skills to effectively access and critically select useful, reliable, and trustworthy information. Therefore, critical thinking and decision-making skills are among the most prominent skills that an individual should have in the 21st century (Binkley et al., 2012). Promoting STEAM education—which is an interdisciplinary approach consisting of science, technology, engineering, art, and mathematics disciplines—can help individuals attain these skills and provide opportunities for learning via real-life applications (Ge et al., 2015). This interdisciplinary and integrated type of education is considered to be significantly contributing to the pivotal skills of individuals such as critical thinking, decisionmaking, creativity, communication, and cooperation (Kardeş, 2020). The skills targeted by science programs, the goals of STEAM education, and 21st century skills overlap. Therefore, in this study, the relationships between attitudes towards STEAM and 21st century skills-specifically, critical thinking disposition and decision-making skills-were investigated.

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Attitudes towards STEAM

By adding the art discipline, STEAM education is created to understand and promote the relationship between the science, technology, engineering, and mathematics (STEM) disciplines (Jin et al., 2012). This approach to education contributes positively to students' cognitive development, as well as their psychological and emotional development, critical and creative thinking, problem-solving skills (Gürliyenkaya-Baş, 2020) and creativity (Aguilera & Ortiz-Revilla, 2021). Due to its utilitarian and instrumental values that promote economic growth and productivity, STEM education is incorporated into scientific, mathematical, and technical disciplines throughout the world (Takeuchi et al. 2020). A course of action for a successful STEM education is to ensure that students gain a positive attitude towards these skills at an early age because it is difficult to change student attitudes that are developed at an early age in the absence of impactful perception-altering situations or regulations (Nacaroğlu & Kızkapan, 2021). Children's participation in integrated STEM activities during their childhood enables them to develop higher order thinking on topics that are beyond the scope of a single subject (Aguilera & Ortiz-Revilla, 2021), and through well-planned STEM education, students can gain a positive attitudes towards STEM-related fields (Tseng et al., 2013).

Critical Thinking Disposition

Critical thinking is defined as a "nonlinear and recursive" process of making purposeful, evaluative, and situated judgments in order to form beliefs and perform actions (Facione et al., 1995). Students need to have critical thinking skills not only to be able to define and overcome the problems encountered in daily life (Nugraheni et al., 2022) but also to prepare them for the competition in the business world (Duffy et al., 2022). The critical thinking process is mainly explained by its cognitive and dispositional dimensions (Facione, et al., 1995). The cognitive skills consist of analyzing, explaining, and interpreting aspects of problems, thinking about the multidimensionality of a problem, evaluating the accuracy and precision of information, and drawing conclusions (American Philosophical Association [APA], 1990; Facione et al., 2000). The dispositional dimension of thinking critically can be defined as seeking alternatives and reasons for a certain situation, having a tendency to use scientific methods in the decision-making process, self-questioning, and being open to new ideas (Facione, 2000). According to Wan and Cheng (2019), critical thinking disposition is a prerequisite for critical thinking because critical thinking disposition expresses the emotional dimension of thinking. In other words, individuals who excel in the cognitive aspect of critical thinking may not necessarily apply them effectively to relevant contexts due to a low level of critical thinking disposition. They defined this unbalanced status as 'pre-critical'. Therefore, both cognitive skills and dispositional dimensions should be taken into account to gain a comprehensive understanding of a person's critical thinking. Studies have shown positive associations between a higher critical thinking disposition and problem-solving skills (Tümkaya et al., 2009) and cognitive flexibility and mathematics achievement (Güner & Gokce, 2021). Furthermore, the degree of critical thinking disposition has been found to be influenced by self-efficacy (Aydın Gürler, 2022), gamified STEM practices (Asigigan & Samur, 2021), the classroom learning environment, and the family environment (Wan, 2022).

Decision-Making Skills

Decision-making is defined as making a choice among many alternatives for the purposes of "accountability, selection, placement, evaluation, diagnosis, and improvement" (Griffin et al., 2012, p.19). During the decision-making process, individuals intend to choose the most probable outcome, that meets their needs among multiple options with differing levels of importance (Byrnes, 2002). This skill is integrated into Turkey's current science curriculum as 'life skills'. Low level of decision-making skills was found to be associated with low academic achievement (Papachristou et al., 2022), low cognitive ability (Demaree et al., 2010; Flouri et al., 2019), including problem solving skills (Yurtseven et al., 2021), and a higher likelihood of maladaptive behaviors including bullying and ADHD (Bubier & Drabick, 2008; Flouri & Papachristou, 2019). Although equipping individuals with better decision-making skills is among the most general goals of education (Clemen & Gregory, 2000), there exists very limited research related to primary school students as the majority of studies are conducted on adults. Some of the activities that improve students' decision-making skills are participation in brainstorming sessions, effective teamwork with their peers, and being active in the problem-solving process (Clemen & Gregory, 2000). STEM applications also include similar activities. During STEM activities, students develop different solutions for real-world problems, decide on the most appropriate solution, test and evaluate their decisions, and make necessary improvements for their evaluation (Ercan, 2014).

The Constructs of Interest and the Role of Gender

The literature encourages the use of STEAM education for the purpose of attaining 21st century skills and dispositions, including critical thinking, problem solving, and decision-making. The art dimension of STEAM education supports the development of cognitive skills such as decision making, thinking, problem solving, collaboration, and communication skills (Taylor, 2016). Critical thinking and meta-cognitive skills develop especially during the applications of STEAM education (Mangold & Robinson, 2013). Some studies conducted with students and teacher candidates suggest that STEM education contributes positively to students' critical thinking and problem-solving skills (Elliot et al., 2001). According to teachers, the STEM approach yields multidimensional thinking and improves students' decision-making skills (Bakırcı & Kutlu, 2018).

STEM education is aimed at training individuals who design and implement products according to problem situations. In addition, STEAM activities aim to support decision-making skills by raising individuals who can reach the most accurate solution for problems (Bybee, 2010; Jonassen, 2011). Critical thinking is an antecedent skill to decision-making, and some literature demonstrates the effectiveness of particular teaching practices—that enhance critical thinking skills—in the decision-making process of individuals (Schraagen & van de Ven, 2008; van den Bosch & Helsdingen, 2002). Critical thinking offers important benefits to individuals by helping them make better decisions both in their private and professional lives (Daft, 2010). Finally, pertaining to gender, numerous studies have found differing degrees of attitude or tendency towards STEM/STEAM (e.g., Karakuş & Bircan, 2022; Knezek et al., 2011; Vervecken et al., 2013); critical thinking disposition (e.g., Emir, 2012; Rudd et al., 2000; Shubina & Kulakli, 2019); and decision-making skills (e.g., Tekin & Ulas, 2016). Therefore, we sought to examine the role of gender with respect to the constructs and their associations.

Significance of the Study

A wide variety of studies on attitudes towards STEAM, critical thinking, and decision-making skills are examined. However, no study has been found that concurrently examines STEAM attitudes, critical thinking and decisionmaking skills. Many studies in the literature show that activities and initiatives related to STEM education in the early years of education affect students' perceptions and dispositions towards the STEM field (Bagiati et al., 2010; Bybee & Fuchs, 2006). Therefore, raising awareness among students about STEM at an early age is necessary to both develop positive attitudes towards STEM and have them pursue a STEM-oriented profession (Wyss et al., 2012). STEAM education plays a central role in helping students acquire 21st century competencies such as creativity, critical thinking, and decision-making (Liao, 2016; Sousa & Pilecki, 2013). By developing students' attitudes towards STEAM, students' critical thinking disposition and decision-making skills can be positively affected. The aforementioned literature provides strong evidence that these three concepts are related to each other (see Section 1.4.). Given that many studies in the literature emphasize the importance of STEM/STEAM education in the primary school (Becker & Park, 2011; Murphy & Mancini-Samuelson, 2012), the following reasons warrant the conduct of this study: the scarcity of studies on primary school students in relation to our constructs; the importance of developing students' attitudes towards STEM/STEAM at a young age and its influence on subsequent attitudes; and the degree to which these attitudes are associated with 21st century skills including attitudes towards STEAM and decision-making skills. Therefore, the aim of this study is to examine the relationships between primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills. Based on the formerly established bi-relations, we propose the conceptual model in Figure 1. Moreover, Kocak et al. (2021) reported that critical thinking mediated the relationship between 21st century skills and problem-solving skills. Based on the literature and the conceptual model in Figure 1, critical thinking dispositions display a possible mediating role in the relationship between attitudes towards STEAM and decision-making skills. Finally, examining the moderating role of gender on these relationships will contribute to theory about the generalizability of the associations.



Figure 1. The conceptual model

In this regard, the following research problems are proposed:

- 1. What are the levels of primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills?
- 2. What are the direct and indirect relationships between primary school students' attitudes towards STEAM, their critical thinking dispositions and their decision-making skills? (Pertaining to indirect relationships, we seek the mediating role of critical thinking disposition on the relationship between attitudes towards STEAM and decision-making skills.)
- 3. Do the direct and indirect relationships between primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills differ according to gender? In other words, does gender moderate the relationships?

Method

Research Design

In this study, we collected cross-sectional quantitative data to analyze direct and indirect relationships between fourth-grade students attitudes towards STEAM, critical thinking disposition, and decision-making skills using structural equation modeling (SEM), which refers to a family of statistical techniques to examine directions and strengths of relationships between multiple variables (Kline, 2011). Additionally, we analyzed the mediating role of critical thinking disposition by using the SEM model and the moderating role of gender after multigroup analyses (Ryu & Cheong, 2017).

Participants

In this study, we sought a normative sample—pertaining to student socioeconomic status and achievement levels—that has a higher probability of representing the overall student population of Turkey. We employed convenience sampling method by considering our selection criteria and selected five primary schools from a district of a city that is located in the Southeast Anatolia Region within 2022-2023 academic year. We obtained ethical approvals and subsequently collected data from 650 fourth-grade students (53.1% female and 46.9% male).

Measures

Attitudes toward STEAM, critical thinking, and decision-making skills were latent factors in the model. The items that predicted these factors had categorical response scales. We quantified the items such that higher values represented more favorable responses for the underlying factor. Gender is measured by a binary item (coded 0 for male and 1 for female).

Students' attitudes toward STEAM were measured by the *STEAM Attitude Scale for Elementary School Students* (Gürliyenkaya-Baş, 2020). This scale consists of 20 five-point Likert-type items—each subdomain was measured by four items—such as 'I am curious about how machines work' and 'I like solving mathematics problems." The responses range from 1 "absolutely disagree" to 5 "absolutely agree." Negatively worded items such as 'I find science lessons unnecessary" were reverse coded. Cronbach's alpha coefficients for items ranged from 0.80 to 0.83. Additionally, reliability coefficients for sub-domains, due to the low number of items, ranged from 'satisfactory' to 'high' (Taber, 2018): Cronbach's alpha coefficient was 0.74 for science, 0.59 for technology,

0.69 for engineering, 0.62 for art, and 0.64 for mathematics. However, the reliability of the whole scale was very good (α =0.82).

We measured critical thinking skills using the *Critical Thinking Disposition Scale* that was developed by Ulucinar and Akar (2021). This scale's items were graded on a four-point Likert scale (from 1 'never'' to 4 'always'). This 18-item scale contains four subscales: skepticism, curiosity, open-mindedness and objectivity/bias. It included items such as '1 try to understand the reason for someone's behavior before judging it'' to measure skepticism, 'I don't believe everything I see or hear. I doubt if it is true'' to measure curiosity, and 'I pay attention to whether there is an implicit meaning in what someone says'' to measure open-mindedness. Negatively worded items that measure the objectivity or bias of students—such as 'I think the ideas of my loved ones are correct''—were reverse coded. The reliability of this scale was good (α =0.81). Cronbach's alpha coefficients of items ranged from 0.79 to 0.81.

Finally, we used 'Decision Making Skills Scale for Primary School Students' (Sever & Ersoy, 2019) to measure students' decision-making skills. Items of this 15-item Likert-type scale had four response categories ranging from 1 "never" to 4 "always" and included items such as "I examine the content of the subject for which I make a decision." The scale of this construct demonstrated very good reliability (α =0.84). Cronbach's alpha coefficients for items ranged from 0.83 to 0.84.

Data Management and Analysis

We applied Anderson and Gerbing's (1988) two-step procedure for SEM analyses. First, we performed confirmatory factor analysis (CFA) to verify the unidimensionality of the factor structures of our latent variables. In the second stage, we fit the data to estimate our hypothesized SEM model. We performed two SEM analyses: the first was performed on the whole sample, and the second was performed by grouping the gender variable. Prior to data analyses, we conducted data diagnostics to check for normality, outliers, and missing data. Some of our categorical variables were slightly skewed. Thus, we used a robust maximum likelihood (MLR) estimator that is robust to the non-normality of the observed variables (Muthen-Muthen, 1998-2017). Mplus has a default procedure to handle missing data via the implementation of the full information maximum likelihood estimator (FIML). Finally, outliers can distort the estimation of fit indices and population parameters (Levs et al., 2018). The literature provides mixed recommendations about the removal of outliers. We adopted Verardi and Dehon's (2010) procedure in Stata to detect multivariate outliers using the 'minimum covariance determinant estimator' which is a more robust variant of the basic Mahalanobis distance. Stata returned 17 possible multivariate outliers. We only removed three cases that were logically unacceptable (i.e., the students who provided extreme responses to both negatively worded items and other items of the same construct). Moreover, both MLR and bootstrapping procedures in Mplus improve standard errors when outliers are present (Muthen-Muthen, 1998-2017). Therefore, to obtain robust estimates and to ascertain ecological validity, the other items were kept in the data.

For evaluating the model fit, Kline (2011) suggests RMSEA to be less than 0.10, CFI and TLI greater than 0.90, and SRMR less than 0.08. We performed CFA on three scales: in line with Gürliyenkaya-Baş (2020), the scale measuring STEAM attitudes consisted of five level-1 factors that are loaded on the main factor (i.e., attitudes towards STEAM), and the other items were defined to measure the corresponding factor without a hierarchical factor structure. In cross-sectional studies, items that measure the same construct are considered to correlate due to the overlapping of the item content (Byrne, 2012), so we allowed residual variances of some items of the same construct to correlate due to the method effect. Our CFA model fits the data well. The analysis produced the following fit indices: $\chi^2 = 1241.285$, df = 932 and p < 0.05; RMSEA = 0.023, CI = [0.019, 0.026]; CFI = 0.947; TLI = 0.943; and SRMR = 0.042. All items had sufficient loadings on factors. We used the same measurement model for mediation analyses. We performed the bootstrapping method, which does not rely on distributional assumptions (Ryu & Cheong, 2017), with 1000 replications to estimate bias-corrected standard errors and confidence intervals of indirect effects (Preacher & Hayes, 2008). The mediation analyses were conducted using Mplus 8 software.

Results

Missing Data

Following the removal of multivariate outliers, the results of statistical analyses were obtained from the remaining data, which contained 647 cases. We examined the data for the missing values and their pattern. Each variable had less than 4% of missing values, which is very little concern in a relatively large sample (Kline, 2011), and the

majority of the missing values were generated due to students' mistakes (specifically, providing multiple answers for the same item). There was no systematic pattern of missing data. Therefore, the Mplus FIML procedure and bias-corrected bootstrap standard errors and confidence intervals were utilized to account for the missing values (Muthen-Muthen, 1998-2017).

Descriptive Statistics

Using Mplus, we obtained correlations and standard deviations of latent variables for the whole sample and the multigroup sample. Descriptive statistics and the results of mediation analyses are reported separately for each cohort. We obtained the descriptive statistics depicted in Table 1 to answer our first research question.

Table 1. Descriptive statistics^{1,2}: Estimated means, standard deviations, and correlations of latent factors

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	All Sam	ple			Female				Male			
	Mean ³ (SD)	Steam	СТ	DM	Mean ³ (SD)	Steam	СТ	DM	Mean ³ (SD)	Steam	СТ	DM
Steam	3.797 (0.666)	1			3.804 (0.625)	1			3.788 (0.709)	1		
СТ	2.838 (0.554)	0.608	1		2.858 (0.544)	0.635	1		2.815 (0.565)	0.587	1	
DM	3.005 (0.556)	0.597	0.798	1	3.044 (0.543)	0.669	0.807	1	2.959 (0.567)	0.524	0.800	1

¹ Abbreviations: Steam = Attitudes towards STEAM; CT = Critical thinking disposition; DM = Decision-making skills ² All correlations were significant

³ Mplus does not produce means if the data is cross-sectional. For comparison, average values of factors, ignoring missing cases, were estimated by their composite values in Stata

Our first research problem sought to determine the level of primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills. Students' attitudes towards STEAM values are of the 5-point Likert-type, and the values of the other two scales are of the 4-point Likert type. The range of these values was divided into five categories, and each category was labeled from 1 (very low) to 5 (very high). Students, on average, had a high level of attitudes towards STEAM (M = 3.797, SD = 0.666), critical thinking disposition (M = 2.838, SD = 0.554) and decision-making skills (M = 3.005, SD = 0.556). In comparison with male students, female students had slightly higher mean scores on all factors. In the correlation matrices, the highest correlation was seen between critical thinking disposition and decision-making skills in all three cohorts. The bi-correlations among factors were higher for female students.

Mediation Analyses

To answer the second research problem, we specified our models based on our conceptual model. To answer our third research problem, we performed multigroup analyses to test whether structural paths are equivalent with respect to male and female students.

In our hypothesized model, student attitudes towards STEAM predicted student decision-making skills and critical thinking disposition, and critical thinking disposition predicted student decision-making skills. We hypothesized that critical thinking disposition is a mediator in the relationship between attitudes towards STEAM and student decision-making. The data fit our model well. $\chi^2 = 1241.285$, df = 932 and p < 0.05; *RMSEA* = 0.023, CI = [0.019, 0.026]; *CFI* = 0.947; *TLI* = 0.943; and *SRMR* = 0.042. The proportion of variance explained on dependent variables (i.e., R-square) was 0.369 for critical thinking disposition and 0.657 for decision-making skills. R-squared values for subdomains of attitudes towards STEAM were 0.466 for science, 0.725 for technology, 0.813 for engineering, 0.773 for art, and 0.507 for mathematics. The results indicated that all specified paths were significant (see Figure 2 and Table 2).



Figure 2. Standardized structural path coefficients

Figure 2 shows that student attitudes towards STEAM significantly predicted student critical thinking disposition ($\beta = 0.608$). Similarly, critical thinking disposition significantly predicted student decision-making skills ($\beta = 0.690$) in this relationship. The smallest effect size was found on the path from attitudes towards STEAM to decision-making skills ($\beta = 0.178$).

Gender Differences: Moderated Mediation

To evaluate the moderating effect of gender on the model, we employed a multigroup analysis (Ryu & Cheong, 2017). We compared an unconstrained model that freely estimated path coefficients to a constrained model that forced corresponding path coefficients to be equal across male and female samples. Unconstrained multigroup acceptable: $\chi^2 = 2405.121, df = 1948 and p < 0.05; RMSEA =$ SEM model fit indices were 0.027 [0.023, 0.030]; CFI = 0.924; TLI = 0.923; SRMR = 0.057. Constrained multigroup SEM model fit $\chi^2 = 2463.606, df = 1953 and p < 0.05; RMSEA =$ indices also acceptable: were 0.028 [0.025, 0.032]; CFI = 0.915; TLI = 0.914; SRMR = 0.064. These two models are nested; therefore, we performed a scaled chi-square difference test for the moderation role of gender: $\Delta \chi^2 = 58.49, \Delta df = 5, p < 10^{-10}$ 0.001. This result indicates that the structural associations differ with respect to gender. In other words, gender moderates the direct and indirect effect sizes. For this reason, we report standardized path coefficients for each cohort separately. Table 2 shows that the standardized path coefficients from attitudes towards STEAM to both critical thinking disposition and decision-making skills were larger for girls. For boys, although the path coefficient from critical thinking disposition to decision-making skills was larger than that of female students, the path from attitudes towards STEAM to decision-making skills was nonsignificant.

Table	2. Sta	andardiz	ed path	coefficients
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	All Sample	Unconstrained Multi	group Model
Outcome variables		Female	Male
Attitudes towards STEAM \rightarrow Critical	0.608*	0.654*	0.588*
thinking Disposition	(0.048)	(0.057)	(0.074)
Critical Thinking Disposition \rightarrow Decision-	0.690*	0.632*	0.740*
Making	(0.050)	(0.069)	(0.075)
Attitudes towards STEAM \rightarrow Decision-Making	0.178* (0.052)	0.266* (0.072)	0.096 (0.078)

Upon obtaining acceptable model fit indices and significant relationships between factors, we report indirect effects of critical thinking disposition on the relationship between 4th grade students' attitude towards STEAM and their decision-making skills following the procedures that are suggested by MacKinnon (2008). For testing the mediation effect with bias-corrected standard errors, we performed the bootstrapping method in Mplus. Additionally, instead of using the Sobel method for testing the significance of the indirect relationship, Mplus employs the default delta parameterization method—from which the Sobel method is derived (MacKinnon, 2008)—by default (Muthen-Muthen, 1998-2017).

Paths	All Sample	Female	Male
Direct effect	0.178**(0.053)	0.266*** (0.075)	0.096 (0.082)
Steam $\rightarrow DM$	CI = [0.079, 0.228]	CI = [0.125, 0.407]	CI = [-0.069, 0.262]
Indirect effect	0.419***(0.045)	0.414*** (0.060)	0.435*** (0.076)
Steam $\rightarrow CT \rightarrow DM$	CI = [0.343, 0.521]	CI = [0.309, 0.545]	CI = [0.300, 0.589]
Total effect	0.597*** (0.042)	0.680*** (0.049)	0.531*** (0.065)
	CI = [0.514, 0.679]	CI = [0.567, 0.765]	CI = [0.390, 0.652]

Table 3. Standardized bootstrap values and their 95% confidence intervals for the direct and indirect effects

Note: Standardized values; standard deviations are given in parenthesis; (*** p < 0.001; ** p < 0.01; * p < 0.05) Abbreviations: Steam = Attitudes toward STEAM; CT = Critical thinking disposition; DM = Decision-making skills

Table 3 shows that the critical thinking disposition partially mediated the association between student attitudes towards STEAM and their decision-making skills in the all sample and the female-only sample. Their significant indirect effects were $\beta = 0.419$ for all students in the sample and $\beta = 0.414$ for female students. For the male-only sample, attitudes towards STEAM had a significant indirect effect on student decision-making skills via student critical thinking disposition ($\beta = 0.435$) and it was larger than that of the female-only sample. The total effect for all samples was ($\beta = 0.597$). Female students had a larger total effect ($\beta = 0.680$) than male students ($\beta = 0.531$).

Discussion

In this study, primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills were examined in connection with their descriptive statistics, structural relationships, and varying degrees of paths in relation to gender. Pertaining to the first research question, we found that primary school students' attitudes towards STEAM, their critical thinking dispositions, and their decision-making skills are at a high level. In similar contexts, primary and secondary school students' attitudes towards STEM were found to range from 'good' to 'high' level (Karakuş & Bircan, 2022; Nacaroğlu and Kızkapan, 2021). The higher attitudes of students towards STEAM at an early age may enable them to willingly participate in activities related to the STEAM discipline in the future. Ersoy and Baser (2012) found that the middle school students' critical thinking dispositions were at a low level, and they related this result to the decreased application of studentcentered teaching in secondary school. In line with our findings, Korkmaz and Yeşil (2009) found that students' critical thinking dispositions were at their highest level at the primary school level and decreased through high school. He attributed these findings to the practices that promote rote learning, the lack of research-inquiryoriented activities, and the deprivation of the students of opportunities to use and develop their critical thinking skills. In contrast to our result pertaining to high-level decision-making skills in primary school, Yurtseven et al. (2021) and Baysal et al. (2021) found their level to be moderate. In the literature, children's overestimations of their abilities and competencies abound. As children grow older, ratings of their competencies and certain abilities gradually decrease as the accuracy of their self-perception increases (Eccles et al., 1993). The literature and our results suggest that as students transition to higher levels of education, their mentioned attitudes, tendencies, and skills likely decrease more. Worldwide demand for cultivating students with these 21st century skills implies the presence of undesired levels of these constructs at the primary school level in other contexts, and this problem calls for more research.

Related to the second research question, the results showed that all identified paths were positively associated and significant. An increase in students' attitudes towards STEAM is associated with higher critical thinking dispositions and decision-making skills. Moreover, as students' critical thinking dispositions increase, their decision-making skills also increase. In various experimental studies, STEM applications influenced students' problem solving and critical thinking skills (Çetin, 2020) and contributed positively to students' attitudes towards STEM and their critical thinking dispositions (Açışlı Çelik, 2022). According to Roberts (2012), when STEM education is properly included in the curriculum, it allows students to think and work creatively, critically, and in teams. Providing students with positive attitudes towards STEAM from an early age contributes to their critical thinking dispositions. Based on the similarity of the decision-making process and the engineering design process, engineering design-based science education is found to be important in the development of students' decision-making skills (Denson, 2011; Jonassen, 2011). Therefore, important contributions can be made to decision-making skills by providing students with positive attitudes towards STEAM starting at an early age and giving importance to group work in STEAM applications. In addition to its direct effect on decision-making, STEAM

attitudes have also been found to have an indirect effect through critical thinking disposition (i.e., partial mediation). In other words, as students' positive attitudes towards STEAM increase, their decision-making skills also increase, partly due to the increase in their critical thinking disposition. Experimental studies have reported that teaching based on critical thinking is effective in the decision-making process (Schraagen & van de Ven, 2008; van den Bosch & Helsdingen, 2002; van Dongen et al., 2005).

For the third research question, we sought the moderating role of gender on the specified associations. According to the multi-group analysis, the findings should be interpreted separately for boys and girls. The direct effect of STEAM attitudes on critical thinking disposition is significant for girls and boys, and it is higher for girls. Therefore, in comparison with boys, as female students' positive attitudes towards STEAM increase, their critical thinking dispositions benefit more than those of male students. The majority of the studies have reported that male students are more interested in STEM-related careers than female students (Azgın & Şenler, 2019; Karakuş & Bircan, 2022; Knezek et al., 2011). Some occupational groups such as engineering, are seen as male occupations in society (Vervecken et al., 2013). However, our findings provide satisfactory evidence that female students gain positive attitudes towards STEM and STEM-related professions, and thus, gender inequality might be mitigated.

Surprisingly, the direct effect of attitudes toward STEAM on decision-making skills was significant for girls but not for boys. In other words, female students' positive attitudes towards STEAM are associated with higher-level decision-making skills, but this association is not significant for male students. Bacanlı and Sürücü (2006) stated that male students are more reckless than female students and that male students tend to avoid taking responsibility in the decision-making process compared to female students. Also, girls use the independent decision-making style at a higher level than boys (Tekin & Ulas, 2016). There is a need for qualitative and experimental studies to explain factors that might explain the moderating role of gender in this finding. According to Weller et al. (2014), children with poor decision-making skills should be helped to develop their skills since inadequacy in decision-making skills at an early age might cause behavioral problems such as risky decision-making in the later stages of life. Young children have difficulty distinguishing between necessary and unnecessary information and eliminating the inappropriate options that they use in the decision-making process due to paying attention to irrelevant stimuli (Howse et al., 2003). Since young children may have difficulty making decisions, improving their attitudes towards STEAM and their critical thinking skills may help them narrow down their options for making decisions.

The results revealed that the indirect effect of STEAM attitudes on decision-making skills through critical thinking disposition was significant for both girls and boys and was higher for boys. While attitudes towards STEAM do not have a direct effect on male's decision-making skills, they might channel this effect through critical thinking disposition. Therefore, to develop male students' decision-making skills by having them develop attitudes towards STEAM, their critical thinking dispositions need to be improved together. Effective use of decision-making skills is directly related to critical and creative thinking skills. While creative thinking skills are effective in creating more than one solution proposal in individuals' decision-making processes, critical thinking skills are effective in choosing the right solution from the proposed suggestions for the solution (Baysal, 2009). The direct effect of critical thinking disposition on decision-making skills was significant for females and males, and it was found to be higher for males. In other words, as the critical thinking dispositions of male students increase, their decisionmaking skills increase more than that of female students. Literature depicts mixed results about the significant effect of gender on critical thinking skills, including nonsignificant differences (Bagheri & Ghanizadeh, 2016; Sezer et al., 2022; Yıldırım & Sensoy, 2017), significant differences that are mostly in favor of females (Rudd et al., 2000; Shubina & Kulakli, 2019), and significant differences that are mostly in favor of males (Emir, 2012; Kartal, 2012). In our study, while the attitudes towards STEAM did not have a direct effect on male students' decision-making skills, the indirect effect through critical thinking disposition was found to be higher. Overall, there are two implications of these gender-moderated mediations: i) female students' decision-making skills can be improved by developing either or both attitudes towards STEAM and critical thinking disposition, and ii) male students' decision-making skills can be improved by developing their critical thinking disposition.

Conclusion

There is an international effort to equip students with 21st-century skills. In this study, the mediating role of critical thinking disposition on the relationship between fourth-grade students' attitudes towards STEAM and decision-making skills was found. Additionally, gender moderated these associations. These findings should guide future actions of policymakers, researchers, and practitioners in terms of: i) the importance of developing students' attitudes towards STEAM and critical thinking dispositions starting from the primary school years; ii) the insignificant association between attitudes towards STEAM and decision-making skills in boys; and iii) in efforts

to improve students' decision-making skills through STEM and STEAM related interventions, the necessity of placing greater emphasis on improving students' critical thinking dispositions, specifically in boys.

Limitations and Recommendations

Due to the limitations of this study, including the cross-sectional nature of the data and the possibility of selfreport bias, evidence obtained from randomized-controlled studies testing these associations will contribute to theory. Specifically, experimental or quasi-experimental designs can be conducted to causally investigate the degree to which enhancing attitudes toward STEAM through various teaching practices improves students' decision-making skills both directly and indirectly. In our study, attitudes toward STEAM did not have a direct association with decision-making skills for male students, and they had a higher indirect association through critical thinking disposition. Qualitative studies can provide insights into the mechanism of the moderating role of gender in these associations. Moreover, STEM education has a positive effect on critical thinking and problemsolving skills (Asisigan & Samur, 2021). Its effect on other 21st century skills such as high-level thinking skills including creativity, analytical thinking, collaboration and reasoning can be examined. Together with the aforementioned recommendations, early interventions can help researchers and policymakers take a lower-cost proactive approach before individuals are near to finalizing their personal characteristics, which are less prone to change as they age.

Author (s) Contribution Rate

All authors contributed equally to the article.

Conflicts of Interest

There is no conflict of interest.

Ethical Approval

Ethical permission (8.3.2022 - E-87841438-604.01.01-218299) was obtained from Gaziantep University Social and Humanities Sciences Ethics Committee for this research.

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Validity and Reliability Study of Listening Attitude Scale for Prospective Teachers

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Validity and Reliability Study of Listening Attitude Scale for Prospective Teachers

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Abstract

The aim of this study is to develop a measurement tool to measure the listening/watching attitudes of pre-service teachers. 387 pre-service teachers were administered the scale, and its validity and reliability studies were conducted by exploratory factor analysis, internal consistency measurement, and confirmatory factor analysis. EFA revealed that the scale has four dimensions. To determine the reliability of the scale, the Cronbach Alpha internal consistency coefficient was calculated at 0.928. In the principal component analysis, Kaiser-Meyer-Olkin (KMO) coefficient was found to be 0.937. In addition, the Barlett Sphericity test was significant ($\chi 2 = 4607.552$; p<0.05). Varimax rotation resulted in factor loadings ranging between 0.37 and 0.91. In CFA, the standardized regression coefficients averaged around 0.700 and the items in each dimension had a significant predictive power. As a result of the analysis, a valid and reliable scale was obtained.

Keywords: Attitude, Listening/watching, Scale development

Introduction

Language is one of the essential elements of communication and one of the most effective tools. Individuals transfer their feelings and thoughts through language. The aim of communication is to deliver the message to the target in the shortest time and in the most understandable way. At this point, it is recommended that individuals learn to listen and gain the habit of listening in order to communicate effectively (Atalay & Melanlıoğlu, 2016). Unlike hearing, listening is an active process based on making sense and associating what is understood with the existing schema. Existing definitions in the literature also support this. Özbay (2005) emphasizes in his definition that listening is a way of learning just like reading, speaking, and observation, and that most of the learning takes place through listening. According to Wolvin (2010), listening is the receiving process of the communication process based on hearing verbal or non-verbal messages, paying attention and interpreting the message, and reconstructing the message. In other words, it is the individual's perception and interpretation of what he or she hears. When the organ of sight is added to the organ of hearing in the listening process, the skill of watching occurs. Listening, which is one of the four basic language skills, has a very important place in our lives because it is part of our daily lives and forms the basis for other language skills. So much so that listening draws attention as the most frequently used skill in communication in researches. According to Göğüs (1978), individuals spend almost half of the time they spend with people by listening; in school, up to 4 hours of listening activity takes place daily in teacher-student communication. In addition to its role in the learning process, listening is also effective in ensuring communication and organizing relationships between individuals in social life. With listening, which is among the basic conditions of healthy communication, individuals can mutually share their feelings, thoughts, concerns, and needs with each other. In addition, listening enables individuals to gain selfconfidence by improving their empathizing, problem-solving, and inference-making skills. Despite its role in both learning and communication processes, listening, which is the basis of communication, has been accepted as a skill that can develop spontaneously, and it is thought that there is no need for training in listening skills (Emiroğlu & Pinar, 2013).

Contrary to popular belief, listening skills are a skill that should be evaluated both in terms of education and affective characteristics such as attitude, anxiety, and motivation. Attitude, which is one of the key concepts in behavioral sciences (İnceoğlu, 2004), is very important among affective characteristics. Attitude is not innate, it is acquired through various experiences. They are emotional, mental, and behavioral tendencies that arise from

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the influence of people, events, and situations (parents, friends, media, etc.) on individuals (Tayşi & Özbay, 2016). The tendency in question can be positive or negative. Individuals accept or reject a group, institution, or idea with a positive or negative disposition (Özgüven, 1994). In this respect, attitudes have a direct effect on individuals' behaviors and skills. The determination of this effect and its reflection on language skills should be investigated. Ignoring the effect of attitudes on skills may cause individuals to have negative attitudes towards language skills in general and listening skills in particular, which causes some negativity in their educational activities and social lives. The consideration of the psychological variable, the determination of its source, and awareness of its conditions prevent the formation of possible negative attitudes. Since listening skill is a skill that involves many factors, individuals may often remain passive in the process; this passivity may cause individuals to get bored and develop negative attitudes towards listening (Goh & Taib, 2006; Tayşi & Özbay, 2016). It is important to determine the emotional, mental, and behavioral tendencies that affect listening skills. The obstacle of individuals' interests, expectations, needs, and personal problems to listening skill has a negative effect on the skill. In cases where the individual is not interested, has negative feelings and thoughts, the teacher's efforts in the lesson or at the point of communication become meaningless. For this reason, the primary goal is to make the current attitude positive, but for this to happen, it is necessary to identify the problem, which is, the negative attitude.

There are studies in the literature to determine students' attitudes. Karahan (2020), who determined the effect of attitude on skills, developed an attitude scale for 5th grade students' attitude towards listening; Daşöz (2013) developed an attitude and anxiety scale for 7th grade students' listening skills; and Tayşi & Özbay (2016) developed an attitude scale for middle school students' attitude towards listening. Bayram's (2019, p.61) detection that "as long as the teacher cannot solve the problems arising from himself/herself, he/she encounters the listening barrier arising from the student's attitude in the classroom" is very important at this point. Considering this determination, teachers need to review their attitudes. Çifci (2001) states that the attitudes and behaviors of the teacher have an effect on the listener. Since pre-service teachers encounter listening barriers such as not being aware of the target, the length of the lecture, not being interested in the subject, being interested in personal problems, staying passive in the lesson, not being able to use the information in the future, not knowing the terms and concepts used, not asking about the points that are not understood, not using the body language of the instructor effectively and trying to take notes of everything explained (Aşılıoğlu, 2009), it is as important to determine the attitudes of teachers or pre-service teachers as it is to determine the attitudes of students.

From this point of view, there was a need to develop a general listening attitude scale suitable for use on all preservice teachers. With the "Validity and Reliability Study of the Listening Attitude Scale for Prospective Teachers", it is aimed to develop a measurement tool with reliability and validity studies to determine the listening attitudes of prospective teachers. The measurement and evaluation approaches used in the listening and watching process, which has an important role in both the daily life and academic life of individuals, are important for the efficiency of the skill and the effectiveness of teaching. The existence of a scale that will reflect and determine pre-service teachers' attitudes towards listening skills is important for the skill. On the other hand, the inadequacy of studies determining pre-service teachers' attitudes towards listening increases the importance of the developed scale. In addition, the scale is expected to contribute to the development of positive attitudes towards listening and shed light on future studies.

Method

This study is a scaling-based research project that was prepared to determine the construct validity and internal consistency reliability coefficient of the listening attitude scale for prospective teachers.

Research Group

The reliability and validity studies of the Listening Attitude Scale for Prospective Teachers were conducted on a total of 387 university students studying at the Faculty of Education and the Faculty of Sports Sciences at Bayburt University in the autumn term of the 2021-2022 academic year. In the selection of the study group an easily accessible sampling method, one of the purposeful sampling methods—was preferred. In this method, the researcher chooses a situation that is close to him/her and, therefore easy to access (Yıldırım & Şimşek, 2011:105). The distribution of the study group that emerged as a result of the selection made is 45% (f=174) of the first grades, 23.4% (f=94) of the third grades, 17.1% (f=66) of the second grades, and 13.7% (f=53) of the fourth grades. The participants forming the study group were included in the study according to the principle of volunteerism. The determination of the sample size was based on five times the total number of items in the scale (Tezbaşaran, 2008; Tavşancıl, 2014). It can be said that the study group is sufficient for reliability and validity

procedures. The distribution of the selected study group according to departments and classes is shown in Table 1:

1	, , , , , , , , , , , , , , , , , , ,	
	Grade Level	f
	1	174
	2	66
	3	94
	4	53
Total		387
	Department	f
	Preschool Education	82
	Guidance and Psychological Counselling	69
	Turkish Language Teaching	66
	English Language Teaching	40
	Classroom Teaching	35
	Physical Education Teaching	34
	Primary Mathematics Teacher Education	33
	Social studies teaching	28
Total		387

Table 1. Descriptive statistics of the study group

Scale Development Process

In the first stage of scale development, the theoretical infrastructure of the concept to be measured and the target group to be used in the scale are determined (Devellis, 2021). In this direction, an item pool of 54 items was created by using the keywords "listening, listening attitudes" in the domestic and foreign literature to determine the theoretical structure of the feature aimed to be measured in the study. These items were presented for consistency to six experts from the Department of Turkish Education and two experts from the Department of Measurement and Evaluation for consistency. In addition, the scale items were also examined by language experts in terms of language and meaning. It was aimed at creating a candidate scale form with feedback from both field experts and language experts. For this purpose, a triple evaluation for each item in the item pool, and the expert who would make the evaluation was asked to tick one of these options. At the end of the marking, it was checked how many experts accepted each item.

In addition, the content validity of the items was tried to be ensured. Content validity is the extent to which the entire scale serves the purpose (Karakoç & Dönmez, 2014). For content validity, the opinions of the experts on the subject are taken. For the content validity of the scale items (Veneziano & Hooper, 1997), the content validity ratio was used. The calculation of the content validity ratio was made by taking one minus the ratio of the total number of experts who responded positively for each scale item to the total number of experts. At the end of this calculation, items with a content validity ratio below 0.80 were removed from the scale. After the expert opinions, final corrections were made, and the 54-item draft scale form was created and made ready for pilot application. The 54-item draft scale was applied to a group of pre-service teachers who had similar characteristics with the target group to determine whether the items were comprehensible or not. With the removal of six items from, the pilot application, the 48-item trial scale was finalized. Thus, a Likert-type measurement tool based on giving information about the individuals involved in the study was prepared. The participants were asked to express their attitudes on a 5-point Likert-type scale ranging from "Strongly Agree, Agree, Somewhat Agree, Disagree, and Strongly Disagree". Depending on the ranking, it was scored as "5, 4, 3, 2, 1".

Data Analysis

The main purpose of scale development studies is to present a valid and reliable scale (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2017). For this purpose, exploratory and confirmatory factor analyses were conducted in the data analysis of the study. SPSS 25 was used in exploratory factor analysis, and IBM SPSS AMOS 26 software was used in confirmatory factor analysis. Since there was no clear information about the number of factors of the measurement tool in the study, exploratory factor analysis was used to obtain information about the nature of the measured factor, and confirmatory factor analysis was used to confirm the hypothesis developed in line with the theory.

Results

The main purpose of the analysis conducted on the attitude scale prepared for pre-service teachers is to demonstrate that the developed scale is valid and reliable. Factor analysis was performed to create a coherent structure among the 48 items planned to be used during the application to measure the attitudes of pre-service teachers towards listening. Item analyses of the items within the structure revealed by the factor analysis were performed. In this section, the values obtained from the analyses are interpreted.

Before the factor analysis, the total score correlation of 48 items was analyzed to create a meaningful whole among the items accepted to be related to the listening attitudes of pre-service teachers and for scale reliability. With correlation, the relationship between the score obtained from the test items and the total score of the test is examined. For item discrimination, the item-total correlation should be 0.30 and above (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2017). The results of the analyses for the items in the scale are presented on the table below:

Table 2. Item total correlations of scale items

Scale Item No	Item Total Correlations
M1	,277
M2	,477
M3	,432
M4	,385
M5	,577
M6	,522
M7	,613
M8	,646
M9	,562
M10	,460
M11	,676
M12	,508
M13	,502
M14	,553
M15	,054
M16	,527
M17	,550
M18	,602
M19	,340
M20	,547
M21	,551
M22	,583
M23	,519
M24	.613
M25	.535
M26	.375
M27	.272
M28	.138
M29	.572
M30	.477
M31	.526
M32	.636
M33	.407
M34	.524
M35	.592
M36	.383
M37	.240
M38	466
M39	.443
M40	103
M41	459
M42	524
M43	,521
M44	502
M45	,562
M46	147
M47	335
M48	,364

The table shows the item total correlation amounts for all items. In item-total correlation analysis, it is expected that the expected item total correlation amount should not be negative, and the item total correlation value should be greater than 0.20 (Sapmaz, et al., 2016). As the table is examined, it is seen that there is no negative value in item total correlations, and the item total correlations of items 15, 28, 40, 43, 45, and 46 are lower than .20. According to these results, items with correlations lower than .20 were removed from the scale. Factor analysis was used to reveal the most appropriate structure possible among the 42 items of the measurement tool that was planned to be used in the actual application. The items within the structure revealed by the factor analysis were analyzed.

Factor Analysis

The aim of the study was to determine the items that would provide a meaningful whole among a large number of items thought to be related to pre-service teachers' attitudes towards listening/watching skills. Since the researcher did not determine the number of dimensions before the analysis, all items related to listening and watching skills were evaluated.

As part of the validity study of the scale to be developed, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted for construct validity. While exploratory factor analysis aims to reach a small number of identifiable, meaningful structures that these variables can explain together among a large number of variables, confirmatory factor analysis aims to evaluate to what extent the factors formed from various variables based on a theoretical basis are compatible with real data (Büyüköztürk, Akgün, Özkahveci, & Demirel, 2004). Depending on the item-total correlation, the remaining 28 items were categorized under four factors, and no item was excluded. Information about the factor is given below.

Construct Validity Results of the Scale

Within the scope of Exploratory Factor Analysis, KMO and Bartlett's Test results were examined to evaluate the suitability of the data obtained from the "Listening/Watching Attitude Scale for Prospective Teachers" for factor analysis. KMO and Barlett Sphericity test results were evaluated to assess suitability. The values determined for the decision of whether the data in the sample are suitable for analysis are presented in the table:

Table 3. KMO value level

KMO Value	Level
0.90-1.00	Perfect
0.80-0.89	Good
0.70-0.79	Medium Level
0.60-0.69	Bad
0.50-0.59	Very Bad
0.00-0.49	Not Accepted

In sampling adequacy, it is accepted that when the KMO value is between 0.90-1.00, the data set can be factorized perfectly; when it is between 0.80-0.89, it can be factorized well, and when it is between 0.70-0.79 it can be factorized moderately when it is between 0.60-0.69 it can be factorized poorly, and when the KMO value is 0.50 or less than 0.50, the data set cannot be factorized.

The results of the KMO and Barlett Sphericity test conducted on the attitude scale prepared for pre-service teachers are presented in the table:

Table 4. Listening/watching attitude scale KMO and Bartlett test results

KMO Measure of Sampling Adequacy		,937	
	Chi -Square	4607,552	
Bartlett's Test of Sphericity	Sd	378	
	Р	,00	

*p<0.05

The KMO (Kaiser-Meyer-Olkin) value to determine the suitability of the data for factor analysis is ,937 and the Bartlett Sphericity Test (Bartlett's Test of Completeness) result is ,00, which shows that the data is suitable for factor analysis (p<0.05). According to Çevik & Akgül (2003), Bartlett's test should be significant, and the KMO (Kaiser-Meyer-Olkin) coefficient should be higher than .50. The chi-square value of 4607,552 and sd of 378 indicate that the data are suitable for exploratory factor analysis. Factor analysis was performed with principal component analysis for the data set whose suitability was proven.



Figure 1. Scatter plot for the items

On the other hand, eigenvalue criteria were utilized to determine the number of factors that would reveal both the small number of items and the most effective way. Based on the literature (Büyüköztürk, Akgün, Özkahveci, & Demirel, 2004), the factors with eigenvalues greater than 1 and 1 were considered significant factors, and in this framework, the eigenvalue data of the scale factor were presented in the table:

Factor Sum of Transformed Squared Weights					
	Eigenvalue	Variance Explained	Total		
1	9,964	35,585	35,585		
2	1,935	6,912	42,498		
3	1,600	5,714	48,212		
4	1,141	4,076	52,288		

Table 5. Eigenvalues and variance ratios for factors

According to the figure and the table, a four-factor structure was formed from 28 items. Factor 1 explains 35,585 % of the total variance, factor 2 explains 6,912 % and, factor 3 explains 5,714 %, factor 4 explains 4,076 %. The eigenvalues are 9,964 for factor 1, 1,935 for factor 2, 1,600 for factor 3 and 1,141 for factor 4. The literature shows that it is quite difficult to keep the variance explained high in the behavioural sciences; for this reason, while it is sufficient to have a variance ratio of 30% in single-factor scales, the variance ratio should be higher in multi-factor scales (Bayram N., 2017). In this context, the variance ratio that the "Listening/Watching Attitude Scale for Prospective Teachers" can explain can be considered as an indicator that the suitability of the developed scale to determine the attitudes of prospective teachers is at an acceptable level. The factor loadings of the items are given below:

Table 6. Factor analysis findings of listening/watching attitude scale for prospective teachers

Item No	1.Factor	Item No	2.Factor	Item No	3.Factor	Item No	4.Factor
M13	,914	M16	,881	M48	,739	M26	,764

M12	,739	M18	,699	M47	,664	M38	,743
M23	,735	M17	,698	M34	,597	M35	,727
M30	,715	M5	,670	M10	,466	M32	,508
M25	,668	M11	,628				
M14	,628	M2	,606				
M21	,606	M9	,546				
M24	,517	M8	,545				
M44	,506	M7	,503				
M41	,375	M42	,496				

In the item factor analysis of the study, a loading value of .35 was accepted as the basis. It is seen that there is a general acceptance in the literature to take between .30 and .40 as a cut-off point for factor loadings (Sheskin, 2011; Tavşancıl, 2014). The fact that the lowest factor loading value after the analysis is above .35 reveals that the factor loading values on the scale are good. Again, during the analyses, attention was paid to the difference between the loadings of the items on the first factor and the loadings on the other factors (,10 and higher), and the overlapping items 1, 3, 4, 6, 19, 20, 22, 27, 29, 31, 33, 36, 37, and 69 were removed from the scale. After this process, factor analysis was performed again, and a scale with 28 items was obtained. When the table is analyzed, the loading values of the items in the first factor vary between .914 and .375. When the items gathered under the first factor were analyzed, it was seen that the items were mostly about the benefits of listening skills to the individual, and for this reason, the first factor was named as "contributions of listening/watching". The load values of the items belonging to the second factor, which consists of 10 items are between ,881 and ,496. Considering that the items under the second factor were mostly activities in the listening process, the second factor was named as "listening/watching process". The loadings of the items belonging to the third factor consisting of 4 items, are between ,739 and ,466. Since the items were based on individual differences in the listening/watching process, the third factor was named as "individual differences in listening/watching". The loadings of the 4 items belonging to the fourth factor are between ,764 and ,508. Since the items under this factor were related to individuals' preferences for listening skills, the fourth factor was named as "prioritizing listening/watching". Expert opinion was taken about the factor nomenclature, and the factor nomenclature was finalized.

Confirmatory Factor Analysis

3 scale forms indicate random marking was determined; it was excluded from the analyses. CFA was conducted on the data obtained from 157 participants. The fit indices of the model obtained from the confirmatory factor analysis conducted to ensure the construct validity of the "Listening/Watching Attitude Scale of Prospective Teachers" were analyzed and presented in a table below:

Fit Criterion	Perfect Fit Values	Acceptable Fit Values	Concordance Value Obtained from the Scale	Degree of Compliance
Chi -Square (p)	-	-	1,124 (p=0,00)	-
Df	-	-	270	-
Chi -Square /df	$0 \le \chi^2/df \le 2$	$\chi^2/df \leq 4$	1,124	Perfect Fit
RMSEA	0,00≤RMSEA≤0,05	RMSEA≤0,08	0,028	Perfect Fit
RMR	0,00≤RMR≤0,05	RMR≤0,08	0,054	Acceptable Compliance
SRMR	0,00≤SRMR≤0,05	SRMR≤0,08	0,060	Acceptable Compliance
GFI	0,90≤GFI≤1,00	GFI≥0,85	0,879	Acceptable Compliance
AGFI	0,90≤AGFI≤1,00	AGFI≥0,80	0,830	Acceptable Compliance

Table 7. Model-data fit indexes
CFI	0,95≤CFI≤1,00	CFI≥0,90	0,979	Perfect Fit
NFI	0,95≤NFI≤1,00	NFI≥0,90	0,979	Perfect Fit

As a result of the confirmatory factor analysis of the listening/watching attitude scale for pre-service teachers, consisting of 28 items with 4 factors formed by exploratory factor analysis, the fit of the data obtained from 27 items with the removal of the 26th item from the scale to the established models was examined.

The data obtained were evaluated according to the perfect fit and acceptable values (Seçer, 2013; Şimşek, 2007). Accordingly, χ^2/df (chi-square/degree of freedom) value was found to be 1,124. A value of 2 or less indicates a perfect fit, and a value of 4 or less indicates that the model has an acceptable fit. According to the results of the analysis, the Chi-square value (x2=1,124, sd=270, p=.00) was found to be significant and acceptable.

When the fit values in the table are examined, all model data fit indices except NFI showed an acceptable value or excellent fit as a criterion value (Seçer, 2013; Şimşek, 2007).

RMSEA value was found as 0.028 in the model. The RMSEA value of the model less than 0.05 indicates an excellent fit, while the RMSEA value less than 0.08 indicates an acceptable good fit. The fit index value obtained as a result of the analysis reveals that the model gives a perfect fit.

RMR fit index was calculated as 0.054 and SRMR fit index was calculated as 0.060. RMR and SRMR values of 0.05 and below indicate a perfect fit, and 0.8 and below indicate a good fit. According to the result obtained, RMR and SRMR values show that the model is in the acceptable fit.

GFI and AGFI values of the model show that GFI is 0.879 and AGFI is 0.830. GFI and AGFI index values of 0.90 and above are an excellent fits, and 0.85 and above are a good fits. Accordingly, GFI values reveal that the model gives an acceptable fit and AGFI values reveal that the model gives an acceptable fit. There are also studies in the literature that accept AGFI \geq 0.80 as an acceptable fit for the AGFI value (Uzun, Gelbal ve Öğretmen, 2010). Considering the obtained fit index values, it is possible to say that the model provides an adequate fit.

When the NFI and CFI fit indices of the model are examined, it is seen that NFI and CFI have values of 0.856 and 0.916, respectively. NFI and CFI values of 0.95 and above indicate perfect fit, and 0.90 and above indicate acceptable fit. The values obtained as a result of the analysis show that NFI and CFI are in perfect agreement.

A confirmatory factor analysis was performed to confirm that the scale has a four-factor structure within the scope of "Model-Data Fit Indices". According to the "Fit Model Estimates" findings, the chi-square value was 303,523, the df value was 270 and the RMSEA value was 0.028. The results are presented in Figure 2:



Figure 2. Path diagram and factor loadings of listening/watching attitude scale for prospective teachers

When the diagram is analyzed, it is seen that the prediction levels of the item scores representing the four factors for the latent variable vary between 0.37 and 0.91. According to the values in the diagram and table, the model data fit indices showed an acceptable value or perfect fit as a criterion value. It can be said that the four-factor structure of the "Listening/Watching Attitude Scale for Prospective Teachers" was confirmed.

Findings on the Reliability of the Scale

In order to prove the construct validity of the Listening/Watching Attitude Scale for Preservice Teachers, the correlation between the sub-dimensions of the scale was calculated and the results are given in the table:

Sub-dimensions (n=387)		Contributions of Listening/Watchi ng	Contributions of Listening/Watchi Individu Listening/Watchi ng Process Difference ng Listening/W ng		Prioritizing Listening/Watchi ng
Contributions of	r	1,000	,618	,482	,383
Listening/Watchi ng	р	,000	,000	,000	,000
Listening/Watchi	r	,618	1,000	,522	,491
ng Process	р	,000	,000	,000	,000
Individual	r	,482	,522	1,000	,282

Table 8. Correlation values between sub-dimensions

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Differences in Listening/Watchi	р	,000	,000	,000	,000
ng Prioritizing	r	,383	,491	,282	1,000
Listening/Watchi ng	р	,000	,000	,000	,000

According to the table, when the correlation value between the sub-dimensions of the developed scale is considered, a positive and significant relationship is found between all sub-dimensions (p<0.01).

When a measurement is made on the listening/watching attitudes of pre-service teachers, the share of the error included in the measurements in the total variability observed in these measurements is a measure of the reliability of the prepared scale (Büyüköztürk, Akgün, Özkahveci, & Demirel, 2004). In this context, Cronbach's Alpha reliability coefficient was calculated to determine how accurately the scale prepared by the researcher measures the trait it wants to measure. A coefficient between .60 and .80 indicates that the scale is reliable; a coefficient between .80 and 1.00 indicates that the scale is highly reliable. The reliability analysis findings of the scale obtained as a result of the information provided and the procedures performed are shown in detail in the table:

Table 9. Listening/watching scale reliability analysis findings

Factor	Coronbach Alpha Reliability Coefficient
Contributions of Listening/Watching	,877
Listening/Watching Process	,874
Individual Differences in Listening/Watching	,665
Prioritizing Listening/Watching	,714
Total	,928

As a result of the analysis, the Cronbach's Alpha reliability coefficient for the entire scale was calculated as .928. This result shows that the scale is a highly reliable scale. In terms of sub-dimensions, the reliability level was calculated as .877 for the factor of contributions to listening/watching; .874 for the factor of listening/watching process; .665 for the factor of individual differences in listening/watching; and .714 for the factor of prioritizing listening/watching. These levels reveal that the internal consistency of the scale in four dimensions is quite high.

After the calculation of Cronbach's Alpha reliability coefficient, factor-based discrimination procedures were performed. Independent samples t-test was used to determine whether there was a significant difference between the arithmetic averages of the scores of the individuals in the lower and upper groups (27%) of the test and the results are presented below:

Table 10. Independent sample t-test of the factors and the scale's top and sub group independent sample t-test

Factor		Ν	Mean	Sd	t	р
Contributions of	Sub Group	104	37,1057	• • •		
Listening/Watching	Top Group	104	48,4134	206	21,279	,000
Listening/Watching Process	Sub Group	104	30,4231	200	20.000	000
	Top Group	104	46,7308	206	30,208	,000
Individual Differences in	Sub Group	104	14 7692			
Listening/Watching			11,7052	206	18 849	000
	Top Group	104	19,2885	200	10,019	,000
Prioritizing Listening/Watching	Sub Group	104	7,1346			
	Top Group	104	12,0673	206	16,139	,000,
Total	Sub Group	104	126,5000	206	36,999	,000,

Top Group	104	89,4327	

Based on the self-efficacy scores ranked from high to low, the lower and upper groups were each formed from 104 individuals each. According to the table, it is seen that the items are significant at p<.001 level. These results reveal that the developed scale can distinguish between the lower and upper groups of 27%.

The item analyses of the data in the Listening/Watching Attitude Scale for Prospective Teachers are presented in a table by comparing the item-total test correlation. With the item-total test correlation, it was tested whether each item in the scale measures the feature it wants to measure and whether it distinguishes individuals in terms of the feature it measures, and items with an item-total test correlation score of 0.30 and above were considered to have good discrimination.

		Item Total		Item Reminder		
Items	Ν	r	р	r	р	
M2	387	,495	,000	,341	,000	
M5	387	,625	,000	,500	,000	
M7	387	,644	,000	,523	,000	
M8	387	,670	,000	,555	,000	
M9	387	,584	,000	,463	,000	
M10	387	,497	,000	,367	,000	
M11	387	,720	,000	,593	,000	
M12	387	,543	,000	,474	,000	
M13	387	,554	,000	,589	,000	
M14	387	,609	,000	,524	,000	
M16	387	,493	,000	,377	,000	
M17	387	,585	,000	,468	,000	
M18	387	,614	,000	,485	,000	
M21	387	,586	,000	,456	,000	
M23	387	,562	,000	,473	,000	
M24	387	,650	,000	,534	,000	
M25	387	,585	,000	,487	,000	
M30	387	,520	,000	,445	,000	
M32	387	,620	,000	,524	,000	
M34	387	,542	,000	,402	,000	
M35	387	,542	,000	,457	,000	
M38	387	,401	,000	,377	,000	
M41	387	,485	,000	,382	,000	
M42	387	,557	,000	,419	,000	
M44	387	,571	,000	,407	,000	
M47	387	,404	,000	,330	,000	
M48	387	,392	,000	,294	,000	

Table 11. Item-total test correlation

When the table is examined, it is seen that the item total correlation values ranged between r = .39 and r = .72 and the item residual correlation values were r = 29. and r = .59 and there was a significant relationship between the scores at .01 level.

Evaluation of the Scores

There are 27 items in the Listening/Watching Attitude Scale for Prospective Teachers. Since it offers a 5-point Likert-type rating, the highest score that can be obtained from the scale is 135 and the lowest score is 27. As the scores obtained from the sub-dimensions of the scale increase, it can be said that pre-service teachers have the characteristics of the relevant dimension at a high level. The application time of the scale is approximately 10-15 minutes.

Conclusion and Discussion

There are many factors that play a role in the realization of communication. There are two basic elements in verbal communication. One of these elements is listening. With the scale developed, it was aimed to determine which attitudes the pre-service teachers selected as the study group have about listening. The aim of the research is to bring a measurement tool aiming to measure pre-service teachers' attitudes towards listening and monitoring skills into the literature. Although there are many measurement tools dealing with different dimensions of listening/monitoring skills, there is no attitude scale for listening/monitoring skills for pre-service teachers, so the validity and reliability analysis of the "Listening Attitude Scale for Pre-service Teachers" was conducted.

It is expected that the scale obtained as a result of the research will contribute to the determination of pre-service teachers' attitudes towards listening/watching skills and the development of similar measurement tools. The high and significant validity and reliability analyses suggest that the developed scale can be used to measure the attitudes of pre-service teachers in the field of listening/watching. In addition, it is foreseen that it can be used in studies on the determination of attitudes.

In the scale developed by Melanlıoğlu (2013) to determine the listening concerns of secondary school students, students' concerns were measured based on five dimensions: "evaluation of listening, watching the listening process, individual differences in listening, focusing on after listening, and listening barriers".

In the scale developed by (Tayşi & Özbay, 2016) in order to measure the attitudes of secondary school students towards listening skills, 4 dimensions were identified as "seeing listening as necessary, individual differences in listening, listening difficulties, and effective listening habits".

Atalay & Melanlıoğlu (2016) reached a three-factor structure as "pre, during, and post listening strategies" in the scale they developed to measure the listening strategies of secondary school students.

Doğan & Erdem (2017) limited the scale they developed for secondary school students to critical, comprehensive, and discriminative dimensions.

Taşkın (2017) developed a three-dimensional scale consisting of the dimensions of "making sense of what is heard, questioning, and interpreting" to measure pre-service teachers' attitudes towards critical listening.

While creating the item pool of the listening/watching attitude scale for pre-service teachers, firstly, an item pool of 54 items was created by using the keywords "listening, listening attitudes" in the domestic and foreign literature. These items were presented for consistency to six experts from the Department of Turkish Education and two experts from the Department of Measurement and Evaluation for consistency. After the expert opinions, final corrections were made, and the 54-item draft scale form was created and made ready for pilot application. The 54-item draft scale was applied to a group of pre-service teachers who had similar characteristics as the target group to determine whether the items were comprehensible or not. With the removal of six items from the pilot application, the 48-item trial scale was finalized. The study was conducted on a total of 387 university students studying at the Faculty of Education and the Faculty of Sports Sciences at Bayburt University in the autumn term of the 2021-2022 academic year.

The analyses of the developed listening/watching attitude scale for pre-service teachers were made with the help of SPSS 22. The Cronbach Alpha reliability coefficient of the listening/watching attitude scale for pre-service teachers was calculated as ,928. This ratio shows that the developed scale is suitable for the use by pre-service

teachers. The Cronbach's Alpha reliability coefficient of each of the 4 sub-dimensions of the scale was calculated separately. Since the first dimension called "contributions of listening" has a reliability coefficient of ,779, the second dimension called "listening/watching process" has a reliability coefficient of ,740, the third dimension called "individual differences in listening/watching" has a reliability coefficient of ,612, and the fourth dimension called "prioritizing listening/watching" has a reliability coefficient of ,612, it can be said that the developed scale is very reliable.

In the literature, it is accepted that the KMO value, which corresponds to the compatibility of the correlation between the sample suitability and the scale item, is above .50. When the obtained data are analyzed, it is understood that the KMO value is .90. A KMO value higher than .70 indicates that the data are suitable for factor analysis. Bartlett's test result ($\chi 2=4607,552$; sd=378 p<.,000) was found significant.

When the data obtained from the study were analyzed, a Likert-type measurement tool consisting of 27 items and 4 factors was prepared. As a result of the analysis performed on the final form of the scale, the lowest score that can be obtained from the scale is 27, and the highest score is 135. The factor loadings of the scale items ranged between 0.37 and 0.91. When the 4-factor structure of the scale was analyzed, it was found that the 10 items belonging to the first factor were classified as "other".

Recommendations

This scale was developed for pre-service teachers' listening/watching attitudes. Scales can be developed for different language skills by conducting the necessary validity and reliability studies.

Ethical Approval

The ethics committee approval required for the research was obtained with the decision of Bayburt University Ethics Committee dated 24/02/2022 and numb orered 35, and ethical rules were followed in all processes of the research.

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The Effect of Social Support on Work-Life Balance: The Role of Psychological Well-Being

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The Effect of Social Support on Work-Life Balance: The Role of Psychological Well-Being

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Abstract

Objective: This research was conducted to determine the relationships between psychological well-being, social support, and work-life balance and the mediating effect of psychological well-being on the relationship between social support and work-life balance. *Methods:* Data were collected from a convenience sample of 277 participants. Data analysis was done with regression and the Pearson correlation coefficient. Regression-based mediation analysis developed by Hayes (2013) was used to examine the mediation effect of psychological wellbeing. *Results:* Work-life balance is negatively related to social support (r=-.51) and, positively related to psychological well-being (r=.50). As a result of the mediation analysis based on regression to determine the mediating effects, it was concluded that psychological well-being had a mediating effect on the relationship between social support and work-life balance. The bootstrapp (10000) method was used to determine whether the mediation analysis was significant. *Conclusions:* These findings suggest that the inverse relationship between social support and work-life balance is at least partly explained by the level of psychological well-being.

Keywords: Work-life balance, Social support, Psychological well-being

Introduction

Health workers (WHO, 2022), defined as all people engaged in improving, protecting, and developing public health, provide important and effective health services for patients within the scope of their job descriptions (Acar, 2018). While performing these services, health workers, like all employees, continue their personal lives outside of their work lives (Kurt, 2016). In general, satisfaction with one's life is related to being satisfied with work and personal life and balancing these two lives (Sen & Hooja, 2018). Work-life balance is the individual's ability to balance his/her private life and work-related wishes and to provide satisfaction in both areas of his/her life (Altun-Dilek & Yılmaz, 2016). Like other employees, healthcare professionals may face various problems both in their personal and working lives (Mohanty, Kabi, & Mohanty, 2019). Health workers' professional and legal responsibilities and obligations may increase in proportion to their work, and they may experience emotional difficulties such as stress (Pozgar, 2020).

This study examines the mechanisms underlying the relationship between social support and work-life balance in healthcare workers working in a hospital setting. It is thought that the variable mediating this relationship is psychological well-being.

Social Support

Social support, which is effective in coping with stress and negative situations against social, psychological, and general problems experienced by individuals, is an important factor for the continuation of human mental health (Hogan, Lindel, & Najarian, 2002). Social support is also defined as ready-to-use help from people with whom the individual is in contact, especially during difficult times when he or she needs support (Pfingstmann, 1987). In addition, individuals meet their social needs, such as love, belonging, and security, by interacting with others (Sollbarra-Rovillard & Kuiper, 2011). Humanity as a social being is involved in communication and interaction with other people, both in personal and business life. Basic social needs such as love, respect, acceptance,

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belonging, identity, and security are met by the communication and interaction resources of the individual (Ben-David & Leichtentritt 1999).

The importance of social support in human life starts from the first moments of life, and it is seen that the need for social support increases with individuals' awareness of their social relationships (Santrock, 2017). However, it is inevitable for people to have difficulties in their lives, and it is important for them to have sufficient social support for the social problems they have experienced and to maintain their general well-being (Abay-Alyüz, 2020; Taylor, 2011). Individuals who receive social support, help others, approach empathically, and have the skills necessary in social relations are generally satisfied with their lives (Taylor, 2011).

It is known that the level of stress and job satisfaction in the work life, where a person spends most of his daily life, is affected by the social support he receives from his close environment (Lambert, Hogan, & Altheimer, 2009). Studies have shown that social support is a basic resource that reduces the negative effects of stressful life events and also affects people's behaviors and the way they fulfill their social roles (Wallace, <u>Paulson, Bond</u>, & Lord, 2005) and has a protective effect on individuals from psychological and physical diseases (Zkody & McKinney, 2019).

Work-Life Balance

For individuals, life constitutes a unity of family, personal, and working life (Ghorbani, 2003). Maintaining a quality life, having a positive interaction with his family and social environment, and meeting the expectations of the employer ensure a balance between work and life (Ekinci & Sabanci, 2020). While work-life balance is defined as success in health, career, and private life, in another aspect, it is evaluated as satisfaction in the fields of work and personal life (Altok-Gürel, 2018). Personal factors such as gender, education, and career planning affect a person's work-life balance with role ambiguity in the job, excess workload, role conflict, organizational management, employee participation in management, the quality of the physical characteristics of the place of work, job security, and similar organizational factors (Ballıca, 2010; Kalliath & Brough, 2008). In cases where a balance between work and life cannot be achieved, behavioral, physical, and psychological consequences arise due to the deterioration of work and family life balance (Quick, Wright, Adkins, Nelson, & Quick, 2013). The effects of work-life imbalance on individuals are observed in general living areas (Ghorbani, 2003). Stress experienced at work greatly affects individuals' family relationships, mental health, well-being, and quality of life outside of work (Losyk, 2006; Özafşarloğlu, & Kılıç, 2013). Studies show that the level of work stress experienced by the employee affects the quality of family conflict and family relationships (Karatepe & Baddar, 2006; Netenmeyer, Alejandro, & Boles, 2004; Vinokur, Pierce, & Buck, 1999).

The Mediator Role of Psychological Well-Being

The main determinant of positive psychology is that it develops a perspective to look at the negative situations and difficulties that individuals encounter in their lives from their positive aspects (Lambert, Passmore, & Holder, 2015). Psychological well-being is one of the concepts that positive psychology focuses on (San, 2015). The concept of well-being in the lives of individuals, on the other hand, can be considered separately from psychological and subjective well-being (Çankır & Yener, 2017). The concept of happiness comes to the fore in the subjective well-being of a person (Bartels, 2015). Psychological well-being, on the other hand, is defined as managing one's life in areas such as maintaining meaningful goals, personal development, and establishing quality relationships with other people despite the existential challenges faced in life, rather than the concept of happiness (Keyes, Shmotkin, & Ryff, 2002). It is seen that self-realization, maturation, full functionality, and individualization, which are prominent elements in the concept of psychological well-being, are among the determinants of the positive criteria of individuals' mental health (Ryff, Magee, Kling, & Wing, 1999). There are six dimensions in Ryff's (1989) psychological well-being model: self-acceptance, positive relationships with others, autonomy, environmental control, life purpose, and personal growth. In this model, psychological wellbeing is explained in terms of emotional, physical, cognitive, spiritual, personal, and social processes. It is thought that with positive relationships with others, which is one of these dimensions, and emotional, social, and instrumental support from the social environment, people's life satisfaction will increase, and they will feel better spiritually (Carol, Ryff, & Singer, 2008). Social support can also be defined as the person's ability to keep in touch with his/her social environment and to establish quality communication (Roothman, Kirsten, & Wissing, 2003). When support is received, it is expected that the person will feel good psychologically (Saltzman, Hansel, & Bordnick, 2020). In addition, it is thought that the factor that will make the person feel good depends on the perceived social support, and there is a positive relationship between social support and psychological well-being (Hellfeldt, López-Romero, & Andershed, 2020). However, the concept of psychological well-being is closely related to psychological resilience (Batmaz et al., 2021; Batmaz et al., 2022).

Present Study

It is thought that the social support that healthcare professionals receive from their environments in coping with the difficulties they encounter in their work lives plays an important role in both their psychological well-being and their work-life balance. It is known that working individuals have difficulties fulfilling their other roles, such as parenting outside of work life, due to the intensity of the time they spend at their jobs, and the intensity at work delays responsibilities outside of work life (Pichler, 2008). Considering the heavy working hours of health workers and the weight of the workload on health workers in Turkey, it is important to examine the mechanisms underlying work-life balance. The research can guide the planning and content creation of intervention studies that will increase work-life balance. In addition, considering the lack of empirical evidence on the factors that affect the work-life balance of health workers after the COVID-19 pandemic, this study analyzes the social support, psychological well-being, and work-life balance described in the literature on the mental health of health workers after the pandemic by using a sample of health workers living in Turkey. Therefore, it is examined whether the variables discussed in the study provide explanatory power in predicting the work-life balance of health workers and whether psychological well-being explains the relationship between social support and work-life balance.

Method

This study was carried out with the relational screening method. This method investigates the existence or degree of co-variation between two or more variables. In this context, the relations between social support, work-life balance, and psychological well-being were examined via correlation and mediation analysis.

Participants

Data were collected from 277 Turkish individuals ($M_{age} = 34.26$, SD= 8.04). Of the participants, 75.8% were female and 24.2% were male. Data related to other demographic information, such as ethnicity or socioeconomic status, were not gathered. Participants were selected using a convenience sampling method and voluntarily completed the questionnaires.

Measures

Psychological Well-Being Scale

It was developed by Diener et al. (2009-2010) to measure psychological well-being to complement existing measures of well-being. The Turkish adaptation of the scale was made by Telef (2013). At the end of the exploratory factor analysis, the total explained variance was 42%. Confirmatory factor analysis values: RMSEA= 0.08, SRMR= 0.04, GFI= 0.96, NFI= 0.94, RFI= 0.92, CFI= 0.95, and IFI= 0.95. The Cronbach alpha internal consistency coefficient was calculated at .80. The item-total correlations of the scale ranged from .41 to .63 (p<0.001). A high score indicates a high level of psychological well-being. In the present study, Cronbach's alpha value was.85.

Work-Life Balance

It was developed by Apaydın (2011) to determine individuals' perceptions of work-life balance. The scale consists of four dimensions. The total reliability of the scale is .91, and the reliability coefficients of the four subdimensions are .88, .81, .77, and .79, respectively. According to the results of the Kaiser-Meyer-Olkin (KMO) and Barlett Sphericity Test, the data are suitable for factor analysis, The KMO of 20 items was calculated as .863 and p = 0.000 (p < 0.001). As a result of the factor analysis, the rate of explanation of the total variance was calculated at 62.423%. In confirmatory factor analysis, fit index values were found to be $\chi 2 / sd = 1.99$, RMSEA= 0.059, SRMR= 0.075, GFI= 0.83, NFI= 0.94, and AGFI= 0.78. In the present study, Cronbach's alpha value was .88.

Swedish Workload-Control-Support Survey

Swedish Workload-Control-Support Survey: The Swedish Workload-Control-Support Questionnaire, developed using the studies of Karasek (1979), consists of 17 questions. Scale Demiral et al. (2007) adapted to Turkish culture. The scale has three main sub-dimensions. These dimensions include 17 questions, including workload (cognitive and quantitative (5)), job control (impact, potentials, meaning, and involvement (6)), and social support (from colleagues and managers (6)) (Hansen et al., 2009). Cronbach's alpha coefficients for the sub-dimensions of the scale range from 0.51 to 0.72. The social support sub-dimension was used in this article. In this study, Cronbach's alpha value for the social support sub-dimension was found to be .84.

Statistical Analysis

In this study, the mediation model was tested to reveal the mediating role of psychological well-being in the relationship between social support and work-life balance. Data were analyzed with the SPSS PROCESS (Model 4) version. Before mediation analysis, data regarding linearity, normality, and multicollinearity problems were checked. Eight outliers that harmed the normal distribution were removed from the 285 raw data collected, and analyses were performed on 277 data. The results are presented in Table 1.

Table 1. Descriptive statistics, linearity, normality, and multicollinearity

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Variables		Ν	Min.	Max.	Means	SD	Skew.	Kurt.	VIF	CI
Work-life balance		277	30.00	96.00	63.54	13.53	.252	239		1.000
Social support		277	6.00	24.00	11.25	3.61	.472	.338	1.194	5.54
Psychological being	well-	277	11.00	56.00	41.18	8.84	536	.466	1.194	15.39

By looking at the skewness and kurtosis values, it was examined whether the variables had a normal distribution, and it was seen that the data showed a normal distribution. It was observed that the skewness and kurtosis values of the variables were in the range of -1 and +1. Since the Variance Amplification Factor (VIF) values were below 10, the multicollinearity problem was not observed.

Results

The relationships between variables were examined with the Pearson correlation coefficient, and the results are presented in Table 2.

Variables	а	b	С
a- Work-life balance	1		
b- Psychological well-being	0.50**	1	
c- Social support	-0.51**	-0.40**	1

**. *p* < 0.001

The relationships between work-life balance, psychological well-being, and social support were examined. As shown in Table 2, work-life balance is negatively related to social support (r = -.51) and positively related to psychological well-being (r = .50).

Mediation Role of Psychological Well-Being

The values in Table 3 showed that social support significantly predicted work-life balance ($\beta = -1.93$, 95% CI: -2.31 – -1.55; *p*<.001).

Table 3. Regression analysis

Predictor	β	SE	р	F	R	\mathbb{R}^2
Constant	85.35	2.28	<.001	100.20	50	0
Social support	-1.93	.19	<.001	100.39	.32	.27

The mediation role of psychological well-being was tested with the mediation model, and the results are presented in Table 4.

Table 4. Mediational model coefficients

	Consequent						
	Psychological Well-Being			Work-Life	Work-Life Balance		
Predictors	Coeff.	SE	Р	Coeff.	SE	р	

Social Support	a -0.98	0.13	0.000	c'	-1.40	0.19	0.000		
Psychological Well-Being				b	0.54	0.08	0.000		
Constant	$i_1 52.30$	1.59	0.000	i_2	56.96	4.68	0.000		
	R = 0.40,	$R^2 = 0.16$		$R = 0.61; R^2 = 0.37$					
	F(1, 275) = 53.39, p = 0.000				F(2, 274) = 81.47, p = 0.000				
		-				-			

Figure 1 and Table 4 show that social support significantly predicts psychological well-being. (Coeff. =-0.98; 95% CI: -1.25 to -0.72; p < .001). Psychological well-being significantly predicts work-life balance (Coeff. = 0.54; 95% CI: -0.38 to 0.70; p < .001), and it also decreases the effect of social support on work-life balance (from -1.93 to -1.40). It is seen that the effect of social support on work-life balance decreases through the variable of psychological well-being (from 1.98 to 1.40). This explains partial mediation.



Figure 1. The mediational role of psychological well-being

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1 adio 5.	Bootstrapping	process of	partial	model

	Coeff	BootMean	BootSE	BootLLCI	BootULCI	
Constant	52.30	52.33	1.56	49.28	55.30	
Social Support → PW-B	98	99	.13	-1.26	72	
Constant	56.96	56.94	5.08	47.14	66.93	
Social Support - W-LB	-1.401	-1.407	.20	-1.81	99	
PW-B → W-LB	.542	.543	.08	.37	.71	

PW-B: Psychological Well-Being; W-LB: Work-Life Balance

In Table 5, direct and indirect path coefficients were significant (bootstrap coefficient =-1.40, 95% CI. =-1.81, -0.99, p<0.001).

Discussion

This study aims to investigate the mediating role of psychological well-being in the relationship between social support and work-life balance. Health professionals perform a stressful profession due to their professional duties and responsibilities such as protecting, saving, and sustaining a person's life (Yüncü & Yılan, 2020). In addition, the COVID-19 pandemic, announced by WHO on March 11, 2020, adversely affected the lives of healthcare workers. Although the pandemic affects all people negatively (Taylor, 2019), it is known that those who are at risk due to their duties during the epidemic tend to experience more negativity and predispose to psychological

problems (Lancee, Maunder, & Goldbloom, 2008; McNeill, Harris, & Briggs, 2016). It has been observed that factors arising from work life, such as increased workload during pandemic times, encountering a heavy virus load, providing care to patients at risk in the context of isolation or quarantine, and a decrease in support systems, increase the physical and emotional load and negatively affect the non-working living spaces of healthcare professionals (Brooks et al., 2018; Xiao et al., 2020). For this reason, it is thought that it is necessary to examine the current work-life balance and the mechanisms underlying the work-life balance of health workers after the pandemic. Therefore, in this study, the mediating role of psychological well-being in the relationship between social support and work-life balance in health workers was investigated. Although these variables have been examined separately, in other samples, or during the pandemic in studies (Bruffaerts et al., 2021; De Kock et al., 2021; Özutku, 2019; Palabiyik & İşözen, 2021; Zhang et al., 2020), It is known that this study is the first to examine these variables in health workers in the same model and after the pandemic.

According to the first finding of the study, social support, which is considered a sub-dimension of work stress, negatively affects work-life balance. Studies have shown that the presence of social support at work has an impact on work-life balance (Dahlem, Zimet, & Walker, 1991; Marcinkus, Whelan-Berry, & Gordon, 2007; Sargent,2000). Work-life balance is the successful continuation of one's work and non-work lives (Blyton & Noon, 2007). Social support, on the other hand, is the contribution and help of one person to another to solve their problems and feel good (Lirio et al., 2007). It is an expected situation that the social support deficiencies of health workers working under intense and severe conditions will reduce their work-life balance. The fact that health workers have social support in the workplace reduces work stress, changes their perspectives on stressful events, develops the ability to cope with the difficulties they encounter in their work and non-work life, and increases job satisfaction (Abadi et al., 2021; Ardahan, 2006; Negussie et al., Kaur, 2016). Sanders (2006) also stated that social support in business life reduces conflicts between one's work and family. This situation can be explained by the presence of social support, the reduction of stress caused by the work, the increase in organizational commitment and job satisfaction, and thus the positive effects of these factors on non-work life.

According to another finding of the study, it was observed that psychological well-being mediated the effect of social support on work-life balance. Social support is defined as a resource that makes the individual feel loved, valued, and like they belong to the interaction unit (Cobb, 1976). Psychological well-being, on the other hand, is expected to be influenced by social support resources, as it focuses on establishing quality relationships with other people as well as components such as self-acceptance, personal development, life purpose, environmental dominance, and autonomy (Ryff & Keyes, 1995). It is known from the studies conducted in the literature that social support has positive effects on the health and well-being of individuals (Holland & Holahab, 2003; Malkoc & Yalçın, 2015; Prati & Pietrantoni, 2010). This situation can be explained by the fact that social support resources provide individuals with the ability to cope with difficult and stressful life events. Wang, Tao, Bowers, Brown, and Zhang (2018) also stated that social support increases psychological resilience and thus increases the wellbeing of the individual by reducing the negative emotions experienced. Similarly, in the absence of social support in business life, it has been observed that work-related stress increases and negatively affects the psychological well-being of individuals (Clair, Gordon, Kroon, & Reilly, 2021). Lack of social support may cause individuals working in the human-oriented service field to feel lonely at work. This, in turn, can negatively affect their nonwork lives by causing them to succumb to work-based stress factors and decrease their well-being (Lambert, Altheimer, & Hogan, 2010). It is an indicator of work-life balance that individuals get satisfaction from their work and non-work lives by minimizing the role conflict in the work and home environments (Guest, 2002). Work-life conflict occurs when an individual cannot fulfill his/her family and life duties while fulfilling the requirements of his/her profession, or if the difficult working conditions of his/her job prevent him/her from regulating his/her life (Frone & Mary, 1992). According to Quick, Nelson, and Hurrel (1997), indicators of well-being such as an individual's participation and belonging in business life, quality relationships established, commitment, satisfaction, and trust are important factors in establishing work-life balance. In a study on health workers, it was observed that as the perception of social support in business increased, emotional exhaustion and depersonalization decreased, while the sense of personal achievement increased (Özbezek et al., 2021). This situation can be explained by the fact that healthcare professionals spend a significant amount of their daily lives practicing their profession, and the occupational group of healthcare professionals includes more human responsibilities than other professionals. These research findings, consistent with the literature, support that social support resources increase the psychological well-being of the individual, and thus the work-life balance of the working individual increases. Especially after pandemic outbreaks such as COVID-19, it is inevitable that healthcare professionals will need support at work to cope with the work stress they experience. With the presence of social support, it can be expected that they can cope with difficult life events, increase their well-being by coping with their negative emotions, and thus establish a balance by minimizing role conflicts in work and home life.

As seen in the results of the research, social support resources and psychological well-being have an important place in ensuring the work-life balance of health workers. However, it was also observed that the effect of social support on work-life balance increased with the presence of psychological well-being.

Conclusion

Considering that healthcare professionals work with long-term and shift-based working hours and encounter dangerous situations in terms of health and safety (Joseph & Joseph, 2016; Palabiyık & İşözen, 2021), it can be considered important to examine the relationship between social support and work-life balance and the underlying mechanisms. The results obtained from the research show that interventions designed to increase the work-life balance of health workers should focus on increasing social support resources and psychological well-being in the workplace. The findings of the research reveal the necessity of a psychological counselor who will work in a preventive and developmental way with the problems they experience at work, career development, and mental health in the institutions and organizations where they are located. It is thought that the research will shed light on the creation of preventive and improvement plans to be prepared for the mental health of employees in health institutions and organizations. Again, individual or group efforts to increase the perception of social support and psychological well-being among health workers in the workplace can also positively affect the organizational commitment and job satisfaction of the employees.

Recommendations

In line with the results obtained from the research, it can be recommended to support the psychological and social resources that health professionals need in order to maintain work-life balance. In this direction, it can be suggested that managers employ psychological counselors who can provide this support to their employees. In addition, it may be recommended to determine the factors affecting the work-life balance and psychological wellbeing of employees in health institutions and organizations and to conduct individual and group counseling intervention studies regarding these factors. In addition, it is important for managers to organize meetings and socializing activities within the institution in order to provide the social support necessary for health workers to maintain their well-being at work. Findings from the study are limited to healthcare professionals. In future research, studies can be conducted on the work-life balance of individuals working in different institutions. and inter-institutional comparisons can be made. The research results are limited to the quantitative data obtained from the scales used in the research. In future research, it may be suggested to obtain in-depth information through qualitative methods in order to determine the factors that increase the work-life balance of the employees. However, in future research, it may be recommended to conduct experimental studies that will improve work-life balance with intervention approaches that include social support resources and psychological well-being.

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Authors Contribution Rate

%20: Hasan Batmaz, %20: Suzan Birel, %30: Emin Kurtuluş, %30: Hacer Yıldırım Kurtuluş.

Conflicts of Interest

There is no conflict of interest between the authors.

Ethical Approval

Ethics committee approval of the study was obtained from a state university in Turkey (25.01.2022, 2022/1).

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Perceived Teacher Informal Relationship Scale: A scale development and measurement invariance study.

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Perceived Teacher Informal Relationship Scale: A scale development and measurement invariance study

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Abstract

This work is intended to develop a measuring tool for determining teacher perception of informal relationships. The pool of items created by researchers through a literature review has been presented with expert assessment of the validity of the content, face, and meaning, and a draft scale has been created by making necessary revisions to the feedback. The draft form was applied to 214 teachers working in the central districts of Diyarbakır, exploratory factor analysis was made on the obtained data set, and a six-dimensional scale structure consisting of 20 items was determined. In order to verify this structure, data were collected from 306 teachers working in the central districts of Diyarbakir, and the six-factor scale structure was confirmed based on the goodness of fit values estimated by confirmatory factor analysis. In addition, AVE (Average Variance Extracted), the root of AVE, composite reliability, and correlation among factors were checked, and it was seen that the scale provided the convergent and discriminant validity conditions as a result of the values reached. For reliability analysis, Cronbach's Alpha coefficients and composite reliability values were checked together, and it was seen that the scale had sufficient reliability values. The measurement invariance of the scale was tested according to the categories of gender (female-male), marital status (married-single), level of employment (primary school, secondary school, and high school), and seniority (1-10 years, 11-20 years, 21 and above), and the formality of the scale, metric, scalar, and strict invariance conditions were found to satisfy. Consequently, it was concluded that the scale in question is a valid and reliable scale that can be used to measure teacher perception of informal relationships.

Keywords: Formal relationship, Informal relationship, Scale development, Factorization, Measurement invariance

Introduction

The quality of their intra-organizational relations (Xue et al., 2020). Inter-organizational relations, which have a critical importance, can be classified as formal and informal relations. While formal relationships are based on laws, written contracts, and formally codified legislation (Prell et al., 2010), informal relationships depend on trust, intimacy, or close relationships within the organization, organizational culture (Monge & Contractor, 2001; Tichy et al., 1979) and organizational climate (Tschan et al., 2004). Fay (2011) states that hierarchical control occurs at a lower level in informal relationships compared to formal relationships. This type of relationship, taking place outside the formal format, is more a reflection of the social aspects of organizations. For example, the connections established outside the formal production relations between employees who make friends or sympathize with each other in an organization are defined as informal relationships (Dymitrowski et al., 2019). When the nature of informal relations is examined, it will be seen that they emerge as a result of requirements that are not provided by formal relations (Aydın, 1994). This type of relationship has the capacity to predict positive results, such as ensuring social control in the organizational sense, resolving relationships with different techniques (Bursalioğlu, 1994) and providing satisfaction in the work environment (Katz & Kahn, 1971). In addition to these, Ergen (2011) states that an informal relationship is an organizational phenomenon where psycho-social needs are met at the same time. Rath (2006), on the other hand, goes beyond these determinations and states that healthy informal relations will be universally good in an organizational sense.

In this sense, it can be said that informal relations are an intangible and powerful source of connection between employees in organizational life (Zou et al., 2010). This type of relationship, which is outside of production relations, is not framed by legislation, but it may have the feature of strengthening the quality of employee

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performance (Yang & Shen, 2014). In cases where formal channels become dysfunctional, organizational costs can be avoided if informal relationships are used (Dyer & Singh, 1998). With its flexibility, strictarity, and capacity to provide practical knowledge exchange, this type of relationship also has the potential to provide a strict culture of cooperation among employees (Poppo & Zenger, 2002).

The capacity to meet the psycho-social needs of the person and the ability to predict positive organizational results may bring an optimistic perspective towards informal relations. However, when evaluated from a wider perspective, it will be easily understood that the event is not so simple and plain. As a matter of fact, besides the relationship of informal relationships with positive results (e.g., organizational commitment, job engagement, employee satisfaction; Shellenbarger, 2000; Sias et al., 2004), negative effects such as the intention to leave, stress, nepotism, and conflict of interest (Berman et al., 2002) were revealed. In this sense, the correct management of informal relationships with a sensitive nature (due to their potential to predict positive or negative results) is of vital importance for organizations. Administrators, being aware of the value of informal relations for the organization, can reveal the potential in the organization and turn it into energy and therefore efficiency; otherwise, managers who are insensitive to this relationship and ignore it in administrative processes will not be able to display an effective management approach. Informal relationships, which can be the source of organizational conflicts (Crabtree, 2004), are an organizational phenomenon that requires good management in this regard. Administrators who can control and care about this informal relationship can achieve a positive school environment and healthy functioning in organizational life (Mosley et al., 1996).

When evaluated as a whole (without concentrating on positive or negative consequences), informal relationships have a quality that can predict important organizational results (Ackermann & Eden, 2011). Especially informal relations having a wide-ranging effect on understanding, making sense, and directing organizational behaviors, are discussed in a broad sense in the field of management (Rank, 2008; Song et al., 2015). Some studies suggest that the type of informal relationship that is not encoded in organizational structure designs is more likely to occur in comparison to the formal relationship. While Mintzberg (2015) states that informal relationships and channels constitute around 45% of organizational life; Van Hoye and Lievens (2009) calculated this rate as 75%. Informal relations, which are an important organizational reality, are expected to be experienced more in schools, which are an open social system, due to the fact that the human element is more effective compared to other organizations (Bursalioğlu, 1994; Hoy & Miskel, 2010). When the informal relationship between teachers, administrators, and students, which does not depend on official rules, is managed and constructed in a healthy way, it can have an impact on reaching educational goals as a potential power in educational institutions (Yang & Shen, 2014; Zheng et al., 2008).

In general, informal relations that start within the institution have the quality to continue outside the institution (Kuipers, 2009). However, as in every social phenomenon, informal relations can also be affected by structural, cultural, and technological changes. Indeed, the proliferation of mass media, social networks, and Web 2 tools in educational institutions globally and nationally, and the realization of COVID-19 pandemic interactions through these tools have naturally changed the structure (Luykx et al., 2020) and quantity (Hazar & Saylık, 2021) of informal relationships. The measurement tools (Memduhoğlu & Saylık 2012; Uğurlu, 2014; Toytok & Doğan 2019) used in the literature to obtain meaningful data on informal relationships were developed before these changes occurred in the global and national sense. Therefore, these measurement tools ignore some indicators of informal relationships. In this study, it is intended to develop a measurement tool to measure teachers' perceptions of informal relationships, taking into account these changes in social life and organizational conditions.

Method

With this study, it was aimed to develop a valid, reliable, and useful scale to measure Teachers' Perception of Informal Relationships (P-TIRS). The study was designed within the framework of a screening design as part of the quantitative research paradigm. Screening design is a research design conducted to determine the attitudes and thoughts of participants regarding a phenomenon under investigation (Fraenkel & Wallen, 1996). Additionally, the steps that DeVellis (2003) stated should be followed in the scale development process were adhered to. According to the author, the steps to be followed in the scale development process are: i) determining the purpose, ii) identifying the qualities to be measured, iii) creating the item pool, iv) examining the item pool and conducting the application, v) determining the psychometric properties.

Working Group

In order to develop the P-TRI scale, two different participant groups in Diyarbakır were studied. Data obtained from 214 teachers was used for exploratory factor analysis, and data from 306 teachers was used for confirmatory factor analysis. The demographic information of the participants is shown in Table 1.

		Group 1	. (N=214)	Group	2.(N=306)
Categories		f -	%	f -	%
Gender	Woman	86	40.2	151	49.3
	Male	128	59.8	155	50.7
Marital status	Married	154	72.0	180	58.8
	Single	60	28.0	126	41.2
Age	21-30	27	12.6	64	20.9
	31-40	63	29.4	67	21.9
	41-50	44	20.6	65	21.2
	51 and above	80	37.4	110	35.9
Seniority	1-10 years	73	34.1	91	29.7
	11-20 years	94	43.9	96	31.4
	Over 21 years	47	22.0	119	38.9
Level of employment	Primary school	69	32.2	100	32.7
	Secondary school	63	29.4	119	38.9
	High school	82	38.3	87	28.4

 Table 1. Demographic Information of Participants

Creating the Scale

A pool of 70 items was created to determine informal relationships by scanning the literature by the researchers (e.g., Dymitrowski et al., 2019; Ergen, 2011; Hazar & Saylık, 2021; Kuipers, 2009; Memduhoğlu & Saylık 2012; Uğurlu, 2014; Toytok & Doğan 2019). These items were first examined by five experts in the field of educational administration, and in line with the evaluations of these experts, five items were excluded from the item pool on the grounds that they were out of content, and 13 items measured the same characteristics as the other items. In line with the recommendations of the experts, two items were added to the pool regarding informal relations. The resulting pool of 54 items was examined by two assessment and evaluation experts in order to get their evaluations in terms of scientific research logic. The two items were corrected on the grounds that they measured more than one thing at the same time and included words that did not have a five-item function. Then, it was examined by two Turkish language experts to check the suitability of the items in terms of language experts, they were corrected, and the items were given their final form. Considering the style of writing the items, the scale was prepared in a five-point Likert type as "I strongly disagree (1)", "I do not agree (2)", "I am undecided (3)", "I agree (4)" and "I strongly agree (5)".

Analysis of Data

The scale was examined by education administration experts for content validity, assessment and evaluation experts for face validity, and Turkish language experts for semantic validity, and necessary revisions were made according to feedback. Afterwards, the factorization of 54 items was started. For the factorization process, Exploratory Factor Analysis (EFA) was performed using the SPSS 22 package program. Kaiser-Meyer-Olkin (KMO) coefficient for the adequacy of the sample number to which the scale items were applied, and Bartlett's Test of Sphericity analyses were performed for the compliance of the items with EFA. A value of over .60 for the KMO coefficient is considered an indication of the adequacy of the sample size, and the significance of the Bartlett's Sphericity Test is accepted as an indicator of the scale's suitability for factor analysis (Tabachnick & Fidell, 2007). Although there are different factorization techniques, the principal components technique was preferred because it was psychometrically powerful, statistically simple, and effective in dealing with uncertainties (Stevens, 1996; as cited in Akbulut, 2010). In EFA, rotation was performed to have more information about the factors. Based on the assumption that the factors were not known in advance and therefore unrelated,

the Varimax vertical rotation technique (Çokluk et al., 2010) was applied. For the evaluation of the indicators, item factor loads and common variance values were taken into account. Since further analyses will be made regarding the scale items, the cut-off point for item factor loads was taken as .50 (Hair et al., 1998). The cut-off point of the common variance value was again taken as .50 (Thompson, 2004), and it was decided to exclude items with lower values from the scale (Kalaycı, 2010).

Confirmatory Factor Analysis (CFA) was performed to confirm the scale structure formed after the factorization process. The χ 2 test, which is the spherical type omnibus test, is usually used to evaluate the fit of the measurement model in DFA. However, since the χ 2 test is sensitive to the sample size, the normed χ 2 (χ 2/*sd*) value obtained by dividing the χ 2 value by the degree of freedom (df) is used (Şen, 2020). A value less than 2 is considered a perfect fit (Tabachnick & Fidell, 2007), while a value below 3 is considered a good fit (Hu & Bentler, 1999). In addition to the normed χ 2 statistic, it is recommended to use TLI (Tucker–Lewis Index), CFI (Comparative Fit Index), SRMR (Standardized Root Mean Square Residual) and RMSEA (Root Mean Square Error of Approximation) values to assess model fit (Xu & Tracey, 2017). Hu and Bentler (1999) CFI and TLI values greater than .95; A RMSEA value of less than .06 and an SRMR value of less than .05 indicate a perfect fit. On the other hand, CFI and TLI values were between .90 and .95; The RMSEA value is between .06 and .10; An SRMR value between .05 - .10 indicates an acceptable fit (Hu & Bentler, 1999).

Composite reliability (CR), average variance extracted (AVE) and correlation values between factors were used to test the convergent and discriminant validity of the scale whose structure was verified. If the CR values of the scale are greater than .70 and the AVE value, and the AVE value is greater than .50, the convergent validity of the scale is; the fact that the square roots of the AVE values are higher than the correlation values between the factors is accepted as a sign of discriminant validity (Hair et al., 2014). In order to test the reliability of the scale, whose construct, convergent, and discriminant validity were tested, Cronbach Alpha (α) values as well as CR statistics were checked. Since the Cronbach Alpha coefficient is based on the assumption that factor loads and error variances are equal, and this situation is not statistically correct (Raykov, 1998), CR values are used together with Alpha values.

Measurement invariance tests were applied to determine whether the scale, whose validity and reliability analyses were performed, measured the same structure in different groups. In the studies where the scale will be applied, it is a very important issue in the comparisons between the groups whether the difference really arises from the group or the measurement tool. In studies where the difference is caused by the measurement tool, comparisons between groups may cause erroneous results (Byrne, 2008). In order not to encounter such a problem, measurement invariance tests are needed (Vandenberg & Lance, 2000).

Measurement invariance is first initiated by the formal invariance test. If the fit values of the formal invariance tests are good or at an acceptable level, the scale is considered to provide the formal invariance condition (Gürbüz, 2019). After the formal invariance condition is provided, metric, scalar, and strict invariance tests are applied, respectively. Significance of χ^2 difference tests ($\Delta \chi^2$) in these nested models, respectively checked, and a non-significant difference is accepted as evidence that these types of invariances are achieved. However, since χ^2 tests are sensitive to sample size, alternative difference fit values are checked. Chen (2007) states that -0.010 $\leq \Delta CFI$ and $\Delta RMSEA \leq 0.015$ values in samples larger than 300 are good cut-off points for the invariance decision.

Results

In this section, first of all, EFA was performed for factorization. Then, the factorization results were validated by CFA. Construct validity, convergent validity, and discriminant validity were tested on the data obtained by CFA. After the validity analyses, reliability analyses were made, and at the last stage, the necessary tests for measurement invariance were applied.

Exploratory Factor Analysis (EFA)

As a result of the exploratory factor analysis, the KMO value was .82 and the Barlett sphericity test ($\chi 2 = 6090.06$; df = 1431; p = 0.00) was found to be statistically significant. Therefore, it was determined that the sampling was sufficient and the data set was suitable for EFA. As a result of factor analysis, it was seen that 20 factors with an eigenvalue greater than 1 emerged from the data set. Afterwards, considering the item contents, six dimensions were determined, and the data set was tested again as six factors. As a result, it was decided to exclude 19 items from the analysis, respectively, because the values they loaded under the two factors were below .10 (Hair et al., 1998). Then, item analyses were made, and items with item load values and common variance values below .50 were excluded from the analysis, starting with the lowest one. As a result of this process, 16 items were excluded from the dataset. A six-factor structure consisting of 19 items was estimated as a result of the analysis. The results of the EFA are given in Table 2.

Factor Loads and Common Variance Values									
Substances	factor 1	factor 2	factor 3	factor 4	factor 5	factor 6	h ²		
m62	0.81						0.67		
m63	0.78						0.67		
m60	0.78						0.72		
m61	0.77						0.64		
m31		0.83					0.58		
m34		0.79					0.72		
m30		0.72					0.55		
m37			0.86				0.83		
m36			0.86				0.80		
m40			0.80				0.66		
m26				0.87			0.70		
m25				0.81			0.76		
m24				0.78			0.80		
m14					0.79		0.70		
m12					0.79		0.65		
m13					0.76		0.67		
m3						0.80	0.68		
m10						0.76	0.73		
m8						0.72	0.67		
Eigenvalue	4.56	2.88	1.99	1.56	1.31	1.17			
Total Explained Var. %	24.01	15.18	10.49	8.25	6.91	6.16			

 Table 2. EFA results for the scale

Note: P-TIRPS= percieved teacher informal relationship

When Table 2 is examined, it will be seen that a scale structure with an eigenvalue greater than 1 and consisting of six factors has been revealed. The eigenvalues and variances of the factors are, respectively, 4.56 (24.01), 2.88 (15.18), 1.99 (10.49), 1.56 (8.25), 1.31 (6.91) and 1.17 (6.16). Six factors have explained 70.99% of the total variance.

The first factor consists of four items with loads ranging from .77 to .81; The second factor consists of four items with a loading value between .71 and .83; the third factor consists of three items with load values between .80 and .85; the fourth factor was loaded between .78 and .87; the fifth factor consisted of three items loaded between .76 and .79 and the sixth factor consisted of three items with a factor loading value between .72 and .80. The common variance values (h^2) of all items were found over .50. This situation can be shown as important evidence for the homogeneity of the scale items (Cokluk et al., 2010).

The six factors created were named "World View", "Social Media", "Motivation", "Syndicate ", "Sincerity," and "Outside the Institution," respectively, by the researchers, taking into account the item contents and related variables.

Confirmatory Factor Analysis (CFA)

CFA was performed to confirm the structure of the scale, which consists of 19 items and six factors as a result of EFA. Single factor, six-factor, and second-order six factor CFA model fit values for the P-TIRs are shown in Table 3.

 Table 3. P-TIRS Fit Values of Models Related to Factor Structure of the Scale

Models	χ^2	df	χ^2/df	р	RMSEA	CFI	TLI	SRMR
Single factor model	2049.516	152	13.48	.000	.202	.338	.255	.162

Six-factor model	208.655	137	1.52	.000	.041	.975	.969	.045
Second order six-factor model	239.086	146	1.64	.000	.046	.968	.962	.066
	· C 1	1 1	• 1					

Note: P-TIRS= percieved teacher informal relationship scale

When Table 3 is examined, it will be seen that all goodness-of-fit indices for the single-factor model are outside the acceptable limits. However, all fit indices of the six-factor model estimated by EFA indicate excellent fit values. In addition, we tested the second-order six-factor model and observed that the results were worse than the fit values of the single-factor model, so we decided to use the single-factor model. In this sense, it is seen that the six-factor P-TIR scale provides the valid conditions for construct validity. The results of the modified measurement model are shown in Figure 1.



Figure 1. Confirmatory factor analysis of P-TIRS

CR, AVE, square root of AVE, correlation between factors, and Cronbach Alpha values were calculated for the convergent validity, discriminant validity, and reliability of the six-factor P-TIR scale. The results obtained are shown in Table 4.

Factor	α	AVE	CR	√AVE	1	2	3	4	5	6
1. World view	.88	.65	.88	.80	1					
2. Motivation	.86	.69	.76	.83	.17**	1				
3. Syndicate	.82	.62	.72	.79	.27**	.12*	1			
4. Sincerity	.80	.59	.70	.76	.17**	.42**	.13*	1		
5. Outside the institution	.86	.68	.76	.82	.24**	.33**	.12*	.28**	1	
6. Social media	.82	.62	.82	.79	.22**	.38**	.14*	.18**	.20**	1

Table 4. Validity and Reliability Statistics of the P-TIR Scale

Note(s): α = Cronbach Alpha; AVE= Avarage Variance Extracted; CR= Composite Reliability; \sqrt{AVE} = The square root of AVE, ** *p*<.01

When Table 4 is examined, it will be seen that the AVE values of all factors were estimated higher than .50 and the CR values higher than .70. In addition, the AVE value for each factor was estimated lower than the CR value. By looking at these statistics, it can be said that the scale provides convergent validity conditions and measures conceptually similar structures.

When the values for each factor are checked, the fact that the CR value is greater than the AVE value and .70 and the square root of the AVE value is higher than the correlation values between the factors can be shown as evidence

that the scale provides the discriminant validity conditions. Based on this evaluation, it can be said that although the scale measures conceptually the same structures, the measurements are different from each other. However, when both Alpha and CR values are controlled, high values are predicted for all factors. Therefore, reaching high reliability values for all factors can be shown as evidence that the scale provides the reliability requirements.

Measurement Invariance

In order to estimate whether the scale measures the same structure according to the categories of gender (femalemale), marital status (married-single), level of employment (primary school, secondary school, and high school), and seniority (1-10 years, 11-20 years, 21 and above). Measurement invariance analyses were performed. The statistics obtained are given in Table 5.

 χ^2 $\Delta \chi^2$ Models df SRMR TLI **RMSEA** ΔCFI ARMSEA CFI Δdf р Female (N=151) Male (155) Configural 409.549 274 .047 .943 .954 .040 model Metric .039 453.702 312 .049 .947 .952 44.153 38 .227 -.002 -.001 model Scalar -.001 472.461 .950 .038 15 .224 -.002 327 .059 .948 18.759 model Strict 490.817 346 .059 .951 .951 .037 18.356 19 .472 .001 -.001 model Married (N=180) Single (126) Configural 523.784 276 .939 .046 .066 .924 model Metric 543.089 313 .064 .938 .943 .042 19.305 37 .992 .004 -.004 model Scalar 556.045 328 .067 .941 .943 .041 12.956 15 .605 .000 -.001 model Strict 579.181 347 .068 .943 .942 .040 23.136 19 .231 -.001 -.001 model Primary School (N=100) Secondary School (119) High School (87) Configural .952 554.515 411 .065 .940 .034 model Metric 654.319 487 .944 99.804 76 -.008 .000 .072 .941 .034 .034 model Scalar .035 -.008 .001 707.947 517 .097 .936 30 .005 .937 53.628 model Strict .036 .005 -.008 771.531 555 100 .933 .928 63.584 38 .001 model 1-10 Years (N=91) 11-20 years (96) 21 + (119)Configural 523.354 411 .063 .952 .962 .030 model Metric 618.356 487 .955 .030 95.002 76 .069 -.007 .000 .066 .953 model Scalar 646.126 517 .073 .957 .956 .029 27.770 30 .582 .001 -.001 model Strict 715.724 555 .078 .950 .946 .031 69.598 38 .001 -.010 .002 model

Table 5. Measurement Invariance Statistics of the P-TIR Scale (N=306)

When Table 5 values are examined; c fit values of the configural model according to gender category $\chi 2$ (274) = 409,549; RMSEA = .040; CFI = .954; TLI = .943; and SRMR = .047. These values, which are evidence of the overall perfect fit of the model, show that formal invariance is achieved. Then, the fact that the p value of all $\Delta\chi 2$ values calculated by gradually comparing each model with the previous model is insignificant and that the Δ CFI and Δ RMSEA values are within the limits of -0.010 and 0.015 reveals that metric, scalar, and strict invariance conditions are provided. Therefore, the insignificance of the $\chi 2$ difference tests and the variation of Δ CFI and Δ RMSEA values within the predicted limits indicate that all stages of measurement invariance are fully provided for the gender category.

Marital status categories were χ^2 (276) = 523.784; RMSEA = .046; CFI = .939; TLI = .924; and SRMR = .066. Based on these values, it can be said that the condition of formal invariance is provided. The fact that the p value of all $\Delta\chi^2$ values calculated by gradually comparing each model with the previous model is insignificant and the change values in CFI and RMSEA are in the range of -0.010 to 0.015 reveals that metric, scalar, and strict invariance conditions are provided. In this sense, both the insignificance of the χ^2 difference tests and the fact that the Δ CFI and Δ RMSEA values do not exceed the predicted limits indicate that all measurement invariance stages are fully provided for the marital status variable.

Fit values of the formal invariance model in terms of the level of employment were $\chi 2$ (411) = 554.515; RMSEA = .034; CFI = .952; TLI = .940; and SRMR = .065. These values, indicating a good fit, show that the formal constancy condition is met. The significance of the p value of all $\Delta \chi 2$ values for which each model is calculated incrementally by comparing it with the previous model is a situation that should be suspected for the metric, scalar, and strict invariance stages. However, the fact that all changes in CFI and RMSEA values are in the range of -.010 to .015 can be shown as evidence of metric, scalar, and strict invariance. In this sense, it can be said that all measurement invariance stages are provided in terms of the level of employment based on Δ CFI and Δ RMSEA values.

For the seniority variable, the fit values of the formal invariance model were $\chi 2$ (411) = 523.354; RMSEA = .030; CFI = .962; TLI = .952; and SRMR = .063. These values show that the necessary conditions for configural invariance are met. Then the fact that the p values of the $\Delta \chi 2$ values of the metric and scalar model, which are calculated by gradually comparing each model with the previous model, are insignificant and the ΔCFI and $\Delta RMSEA$ values are within the limits of -.010 and .015 show that the metric and scalar invariance is fully achieved. On the other hand, if the p value of the $\Delta \chi 2$ value of the strict invariance model is significant, it is a situation that requires suspicion that strict invariance is achieved. However, the change in CFI and RMSEA values in the range of -.010 to .015 can be shown as evidence that the necessary condition for strict invariance is fulfilled. Based on all these data, it can be concluded that formal, metric, and scalar invariance are fully provided and strict invariance is partially provided in terms of seniority category.

Discussion and Conclusion

Informal relationships, which are shaped outside the formal format in organizational life and can have a sensitive nature in terms of the positive and negative outcomes that they can predict, are an important organizational reality. Structural, cultural, and technological developments in the global and national context have caused systematic changes in both the sociological structure and working conditions, and this has also changed the structure and quantity of informal relations. In this study, it was aimed to develop an informal relationship perception scale (P-TIR) for teachers, who are seen as one of the most important stakeholders of the education system, where these changes occur violently.

Although there are measurement tools available in the literature to assess teachers' informal relationships (e.g., Memduhoğlu & Saylık 2012; Uğurlu, 2014; Toytok & Doğan 2019), significant changes have occurred in informal relationships in the education context at the national and global level in recent years. The widespread use of mass media, social networks, and Web 2.0 tools in educational institutions, the intensification of interactions through these tools during the COVID-19 pandemic, and their effects on the structure and quantity of informal relationships (Hazar & Saylık, 2021; Luykx et al., 2020) highlight the importance of considering these changes in the development of such tools. Additionally, measurement invariance tests were applied to the P-TIR scale to demonstrate that the variance stems from the informal relationship itself rather than various variables (gender, marital status, rank, seniority), contributing to the literature.

First, to develop the scale, a literature review was conducted by the researchers, and an item pool of 70 items was created. Five experts in the field of educational administration were consulted for content validity; It was examined

by two assessment and evaluation experts for face validity and two Turkish language experts for semantic validity. Necessary revisions were made according to the feedbacks, and a draft scale of 54 items was determined. Afterwards, EFA was applied to the draft scale. It was observed that 20 factors emerged with EFA, and then the data set was reanalyzed by determining six dimensions, taking into account the item contents. Due to factor loadings, common variance values, and loading under multiple factors, 35 items were excluded from the analysis, and a 20-item scale structure consisting of six dimensions was estimated. "Social media" and "World view" dimensions are four items each; the dimensions of "Motivation", " Syndicate", "Outside the Institution" and "Sincerity" consist of three items each. The scale explains 70.99% of the total variance in general, and it is accepted that this value is over 50% (Liau et al., 2011).

To confirm the scale structure determined as a result of the EFA analysis, a CFA was conducted testing for single-factor, six-factor, and second-order six-factor models. When the model fit values of the single-factor model were checked, it was found that they were outside the acceptable limit (χ 2/df=13.48; RMSEA= .202; CFI=.338; TLI=.255; SRMR=.162). Therefore, the scale is not suitable for one-dimensional use. However, it was observed that the fit values of both the six-factor model (χ 2/df=1.52; RMSEA= .041; CFI=.975; TLI=.769; SRMR=.045) and the second-order six-factor model (χ 2/df=1.64; RMSEA= .046; CFI=.968; TLI=.962; SRMR=.066) were within acceptable limits. Therefore, the P-TIRS can be used as both a six-factor and a second-order six-factor scale.

Using the standardized item values and residual values obtained by DFA, the values of CR, AVE and AVE's square root were obtained. These values were also evaluated together with the Pearson correlation values between the factors, and the convergent and discriminant validity of the scale were checked. After controlling these values, it was determined that the scale provided both convergent and discriminant validity conditions. Parallel to this, both Cronbach Alpha and CR values were controlled together, and it was observed that these values were above .70. Therefore, it has been estimated that the scale has a reliable structure.

At the last stage, measurement invariance analyses were conducted to determine whether the scale would measure the same construct in terms of different groups in comparative studies. Formal, metric, scalar, and strict invariance tests of the scale were performed according to the variables of gender, marital status, level of employment, and seniority. It was revealed that formal, metric, scalar, and strict invariance were fully achieved in terms of gender and marital status variables with these tests, due to both the insignificance of the χ^2 difference test and the fact that the change in RMSEA and CFI values were within the threshold values. χ^2 difference tests were found to be significant in terms of seniority, and level of employment and this revealed a questionable situation regarding measurement invariance in terms of these variables. However, the χ^2 values, which are sensitive to sample size, as well as the change in CFI and RMSEA values, were controlled. Since the change in these values is within the threshold values, it has been observed that the scale meets the formal, metric, scalar, and strict invariance conditions in terms of seniority and level of employment. Based on these results regarding the measurement invariance of the scale, it can be used reliably in comparative studies as it measures the same structure in terms of gender, marital status, seniority, and level of employment.

In this sense, as a result of all these evaluations, it can be said that the P-TIR scale has structural, convergent, and discriminant validity, has good reliability values, meets measurement invariance criteria, and can therefore be used safely in order to determine teachers' perception of informal relations. All items of the P-TIR scale were coded positively. The scale has been prepared as a five-point Likert type. The highest score a participant could get from the scale was 95; the lowest score is 19. A high score indicates a high level of perception of informal relationships; low scores indicate low informal relationship perception level. Therefore, researchers who will apply the scale are expected to pay attention to this issue.

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Authors Contribution Rate

In general, the contribution rate of the first author to the research is 50%. The contribution rate of the second author to the research is 30%. The contribution rate of the third author is 20%.

- Author 1: Designing the research, determining the method, counseling, validity and reliability studies.
- Author 2: Designing the research, reporting.
- Author 3: Data analysis and reporting

Conflicts of Interest

There is no conflict of interest in the research.

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21st Century Skills of Pre-service Teachers and Visions of Faculties of Education in Acquiring 21st Century Skills

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Abstract

This study aims to reveal the situation of pre-service teachers in terms of having 21st century skills and their opinions on faculties of education in terms of enabling them to acquire these skills. In the study, which was designed as an explanatory mixed method, 621 pre-service teachers and 26 pre-service teachers were included in the quantitative and qualitative dimensions, respectively. To collect the data, the "Multidimensional 21st Century Skills Scale" and the "Semi-Structured Interview Form" were used. In the analysis of quantitative data, descriptive statistics, an independent sample T-test, an ANOVA test, and the Scheffe test were used. In the analysis of qualitative data, content analysis was used. In the quantitative aspect of the study, it was concluded that the 21st century skills of the pre-service teachers were at a high level. In the qualitative dimension of the study, it was obtained that pre-service teachers had learning and innovation skills, knowledge, media and technology skills, life and career skills; they thought that teachers, parents, academicians, the individual himself or herself, and bureaucrats were responsible for enabling them to acquire 21st century skills; there were strengths of faculties of education in enabling them to acquire 21st century skills.

Keywords: 21st century, 21st century skills, Pre-service teachers, Faculties of education.

Introduction

Since 21st century skills are comprehensive and multidimensional, it is not possible to make a standard definition for them. For this reason, many institutions and organizations have created some classifications about what 21st century skills should be. Among various project studies and published reports aimed at identifying 21st century skills, the Partnership for 21st Century Skills [P21] is the most widely accepted one and has the largest stakeholder network. The Partnership for 21st Century Skills [P21], 2019) expressed these skills as "problem solving, innovation and creativity, cooperation, and communication skills within the scope of learning and innovation skills; information, media, and technology literacy within the scope of information, media, and technology skills; flexibility and adaptability; entrepreneurship and self-management; productivity and accountability; social and intercultural skills; leadership and responsibility skills within the scope of life and career skills".

21st century skills can be described as the skills that individuals are expected to have in the century that we live in. This expectation has led to the need to teach 21st century skills to individuals. In parallel, teachers, education professionals, and business leaders have provided a framework for these skills (Bozkurt, 2021; P21 Leadership States, 2017). In this framework, which was put forward as the 21st Century Learning Framework (P21, 2019), it is aimed that students acquire 21st century skills by providing active participation in the learning process with the support systems of a) Standards & Assessments, b) Curriculum & Instruction c) Professional Development d) Learning Environments.

It is only possible for students to acquire 21st century skills with an effective education. With an effective education to be carried out under the responsibility of teachers, these skills can be gained at all educational levels, from primary school to higher education (Anagün et al., 2016). In this context, the competencies of teachers and preservice teachers who will enable 21st century learners to acquire these skills become prominent. To effectively enhance and implement 21st century skills, teachers must possess a comprehensive understanding of these skills. As the instructor of future teachers, teacher training plays a crucial role in providing them with the necessary knowledge and skills to master these competencies (Valli, Perkkilä, & Valli, R. (2014). Numerous studies in the

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literature have emphasized that educators must take into account the requirements of the 21st century when designing their instructional approaches and that learners of the 21st century should possess novel knowledge and abilities (Burns & Sinfield, 2004). Teachers who will enable the students to acquire these skills should be open to developments, can empathize with their students, have effective communication skills, solve problems, be open to criticism, and apply teaching methods and techniques that enable the active participation of students (Bayrak Özmutlu & Ergan, 2022; Michaels et al., 2015). Within this context, pre-service training of teachers is of great importance in the training of teachers with these qualifications.

Faculties of education play a vital role in preparing future teachers with the skills and knowledge required to thrive in the 21st century. Faculties of education must equip their students with the necessary competencies to enable them to effectively teach these skills to their own students. By providing future teachers with an education that emphasizes these skills, the faculties of education can ensure that the next generation of students will have the skills and knowledge necessary to succeed in a rapidly changing world (Bayrak Özmutlu & Ergan, 2022). This aim can be achieved by updating the curriculum implemented in the faculties of education. The variability in the needs of the learners, developing teaching technologies, dynamic professional development understanding, and student-based learning approaches have made it necessary to update the curriculum implemented in the faculties of education [TED], 2009); Yalçın, 2018). For these updated studies, information is needed on what the 21st century skill levels of preservice teachers are and what variables affect their skills; what the strengths and weaknesses of faculties of education. In this context, when the studies on the subject are examined, it is seen that the literature does not contain enough data for updating the curriculum. Within this context, this study tries to provide the data needed for updating the curriculum in the faculties of education.

In the literature, various studies have been conducted to develop an assessment tool to determine the 21st century skill levels of teachers and pre-service teachers (Anagün et al., 2016; Çevik & Şentürk, 2019), to examine the 21st century skill levels of pre-service teachers and to examine these skills in terms of some variables (Aktas, 2022; Aydın & Tan Şişman, 2021; Canpolat, 2021; Erten, 2020; Gömleksiz, Sinan, & Döner Doğan, 2019; Kozikoğlu & Altinova, 2018; Özdemir Özden et al., 2018), to obtain pre-service teachers' opinions by quantitative research (Bayrak Özmutlu & Ergan, 2022), and to obtain pre-service teachers' opinions using mixed method (Bozkurt, 2021). In this study, unlike other studies, the 21st century skill levels of pre-service teachers are revealed according to the number of social activities they participate in, the 21st century skills that pre-service teachers think they have, their opinions on the stakeholders responsible for enabling students to acquire 21^{st} century skills, the strengths and weaknesses of the faculties of education, and what needs to be done by the faculties of education. In most studies, it has been emphasized that studies examining the 21st century skills of pre-service teachers who will train 21st century learners should be conducted and that data should be provided for policies to be developed in this regard (Anagün et al., 2016; Arslan, 2020; Aydın & Tan Şişman, 2021; Bayrak Özmutlu & Ergan, 2022; Kozikoğlu & Altınova, 2018). Motivated by the information presented in the literature, this study will make it possible to reveal the current situation of the faculties of education in the process of acquiring 21st century skills. In addition, the data obtained will contribute to the updating of the studies of the curriculum implemented by the faculties of education.

Based on this, the aim of the study is to reveal the situation of pre-service teachers in terms of having 21st century skills and their opinions on the conditions of faculties of education in terms of enabling them to acquire these skills. Within the scope of this purpose, the following questions were sought to be answered:

- 1. What are the 21^{st} century skill levels of pre-service teachers?
- 2. Do pre-service teachers' 21st century skill levels differ significantly according to gender, GPA, and the number of social activities they participate in?
- 3. What are the 21st century skills that pre-service teachers think they have, and what are their opinions on the role of faculties of education in enabling them to acquire these skills?

Methodology

In this section, the design of the research, participants, data collection tools, data collection process, and data analysis are presented.

In the study, an explanatory mixed method design was preferred. Mixed-methods research forms a synthesis between quantitative and qualitative research. In this way, the weaknesses of both research methods are eliminated. In the explanatory design, the research problem starts with a quantitative study and a qualitative study is carried out to explain the quantitative data (Creswell, 2021). In this design, qualitative data is collected with the thought that quantitative data will not be enough to explain the research results, and these collected data are evaluated together with quantitative data.

Participants

In the study, quantitative and qualitative data were obtained. Accordingly, in this section, the data related to the population and the sample of the quantitative data and the participants related to the qualitative data are given below under separate sub-titles.

Population and Sample for Quantitative

The population of the study consisted of pre-service teachers studying at Hatay Mustafa Kemal University in the academic year 2022-2023. In the sample of the study, there were 621 pre-service teachers selected from the specified population by the convenience sampling method. Convenience sampling is a method in which the most suitable sample is determined in terms of time, money, and labor based on the purpose of the study (Balc1, 2020; Büyüköztürk et al., 2020). The descriptive data of the pre-service teachers included in the sample of the study are shown in Table 1.

Table 1. Descriptive data of pre-service teachers in the sample group

Variables	N	%	
Gender			
Male	262	42.2	
Female	359	57.8	
Grade			
1 st Grade	94	15.1	
2 nd Grade	81	13.0	
3 rd Grade	189	30.4	
4 th Grade	257	41.4	
GPA			
Less than 2.50	65	10.5	
2.50-3.00	220	35.4	
3.01-3.50	291	46.9	
3.51-4.00	45	7.2	
Graduated High School Type			
Anatolian High School	409	65.9	
Vocational High School	50	8.1	
Imam Hatip High School	29	4.7	
Other	133	21.4	
Number of Social Activities Participated in			
1	267	43.0	
2	151	24.3	
3	100	16.1	
4 and above	103	16.6	
Education Level of Mother			
Illiterate	104	16.7	
Primary School	303	48.8	
Secondary School	85	13.7	
High School	83	13.4	
University	46	7.4	
Education Level of Father			
Illiterate	23	3.7	
Primary School	235	37.8	
Secondary School	119	19.2	
High School	124	20.0	
University	120	19.3	
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Total	621	100	

When Table 1 is examined, it is seen that 262 (42.2%) of the pre-service teachers were male and 359 (57.8%) were female; 94 (15.1%) of them were in the 1st grade, 81 (13%) of them were in the 2^{nd} grade, 189 (30.4%) were in the 3^{rd} grade, and 257 (41.4%) were in the 4^{th} grade. The GPA of 65 students (10.5%) was below 2.50; 220 students (35.4%) had a GPA in the range of 2.50-3.00; 291 students (46.9%) had GPA a in the range of 3.00-3.50, and 45 students (7.2%) had a GPA in the range of 3.51-4.00. Moreover, it is seen that most of them were Anatolian high school graduates, participated in 1 social activity, and their parents were primary school graduates.

Participants of Qualitative Data Collection

In the study, maximum variation sampling, one of the purposive sampling methods, was used to get the opinions of pre-service teachers on 21st century skills. In maximum variation sampling, similar situations are determined in relation to the problem being investigated, and research is carried out on these situations (Büyüköztürk et al., 2020). The most important purpose of this sampling method is to reflect the diversity of individuals who may be parties to the researched problem at the maximum level (Yıldırım & Şimşek, 2018). Accordingly, in the study it has been tried to ensure maximum diversity by including pre-service teachers with low, medium, and high 21st century skill levels. Within the scope of the study, interviews were conducted with 26 pre-service teachers. The data reflecting the descriptive characteristics of the pre-service teachers who participated in the study is given in Table 2.

Tablo 2.	Descriptive	data of the	interviewed	pre-service teachers

			The number				
				of	Graduated	Education	Education
Code	Gender	Grade	GPA	participants	High School	Level of	Loucation Louol of Eather
				in social	Туре	Mother	Level of Father
				activities			
I1	Female	4 th	2.80	7	IMHS	Illiterate	Illiterate
I2	Female	3 rd	3.30	5	AHS	Primary	University
I3	Male	4^{th}	2.60	15	AHS	Primary	Secondary
I4	Male	4 th	3.00	16	AHS	Primary	University
I5	Male	3 rd	3.00	8	AHS	Primary	Secondary
I6	Female	4 th	2.90	1	AHS	Primary	High School
I7	Female	4^{th}	3.07	1	AHS	Secondary	Secondary
I8	Female	3 rd	3.00	3	AHS	Primary	Primary
I9	Female	3 rd	1.50	18	AHS	Primary	High School
I10	Male	4 th	3.00	20	AHS	Primary	University
I11	Female	4 th	2.80	3	AHS	Illiterate	Primary
I12	Female	4 th	2.98	2	AHS	Illiterate	Primary
I13	Male	4 th	2.95	14	AHS	High School	High School
I14	Male	4 th	2.63	23	IHHS	High School	University
I15	Female	4 th	2.87	8	AHS	Primary	University
I16	Female	4^{th}	3.40	5	IHHS	Primary	Primary
I17	Male	4 th	3.00	9	AHS	Primary	Illiterate
I18	Female	4 th	3.01	4	AHS	Primary	University
I19	Male	4 th	3.52	4	AHS	Illiterate	Illiterate
I20	Female	4 th	2.50	2	AHS	University	University
I21	Female	4 th	2.99	5	AHS	Lise	Primary
I22	Female	4^{th}	3.12	10	AHS	Primary	University
I23	Female	4 th	2.90	4	AHS	Secondary	Secondary
I24	Male	4 th	3.00	4	AHS	Illiterate	Illiterate
I25	Female	4 th	2.95	8	AHS	Secondary	University
I26	Female	3 rd	3.00	5	AHS	Secondary	Secondary

Note: I: Interviewee; IHHS: Imam Hatip High School; AHS: Anatolian High School

As can be seen in Table 2, nine of the pre-service teachers were male and seventeen of them were female. In addition, they were mostly in 4th grade, their GPA was between 2.50-3.00, they participated in social activities, and they were Anatolian high school graduates.

Data Collection Tools

In this section, information about the data collection tools used in the study is given.

Multidimensional 21st Century Skills Scale

In the study, the "*Multidimensional 21st Century Skills Scale*" developed by Çevik and Şentürk (2019) was used to determine the 21st century skill levels of pre-service teachers. There are different scales measuring 21st century skills in the literature. However, since this scale includes all dimensions of 21st century skills, it was preferred within the scope of the study. The scale consists of "Information and Technology Literacy Skills", "Critical Thinking and Problem-Solving Skills", "Entrepreneurship and Innovation Skills", "Social Responsibility and Leadership Skills" and "Career Consciousness". There are 41 items on the scale, 34 of which are positive and 7 of which are negative. The items on the scale, which is a 5-point Likert type, range as "Totally Agree: 5, Agree: 4, Neither agree nor disagree: 3, Disagree: 2, Strongly Disagree: 1". The lowest score that can be obtained from the scale is 41, and the highest score is 205. The high mean score obtained from the scale was interpreted as a high level of 21st century skills of pre-service teachers. In the original study, the Cronbach's Alpha reliability coefficients of the sub-dimensions of the scale were found to be .88, .75, .86, .78, .80, respectively. The Cronbach's Alpha reliability coefficient of the overall scale was determined to be .90. According to this value, it can be said that the scale has a high degree of reliability (Büyüköztürk, 2020).

Semi-Structured Interview Form

In the study, a semi-structured interview form developed by the researcher was used to get the opinions of preservice teachers about 21st century skills. First, a draft interview form was created by considering the purpose of the research and the principles of developing a semi-structured interview form (Yıldırım & Şimşek, 2018). The draft interview form was sent to the experts to examine and get the necessary feedback. For this purpose, six experts—two in the field of qualitative research, two in the field of curriculum and instruction, one in the field of measurement and evaluation, and one in the field of Turkish education—were consulted, and they provided feedback on the draft interview form. After getting expert feedback, a new question was added to the interview form, and one question was changed. Some of the changes made to the interview form are as follows:

- 1. The question of "Who do you think has a role in the development of 21st century skills? What should these people do? Can you explain?" was added to the interview form.
- 2. The question of "What are the negative aspects of faculties of education in gaining 21st century skills? *Explain*?" was changed to "What are the aspects of faculties of education that you see as lacking (problematic) in enabling students to acquire 21st century skills? Please explain?"

Finally, pilot interviews were conducted with three pre-service teachers using the interview form. As a result of these interviews, it was determined that there were no questions that were unclear or understood differently.

Data Collection Process

In the study, first of all, the "*Multidimensional 21st Century Skills Scale*" and the "*Personal Information Form*" were applied to determine the 21st century skill levels of pre-service teachers. These forms were printed out and filled out by the students in October 2022. It took approximately ten days to collect the quantitative data. After the collection of quantitative data, the collection of qualitative data was started. After the pre-service teachers to be interviewed were determined, the interviews were held in four separate sessions. Seven pre-service teachers were interviewed in the first session, five in the second session, six in the third session, and six in the fourth session. The pre-service teachers were informed about the purpose and scope of the study. Additionally, it was stated that if there was a question that was not understood, they could ask questions. They were requested to write explanatory and long answers instead of short ones while answering the questions. In this process, necessary explanations were made to the pre-service teachers who wanted explanations about the questions in the interview form. The collection of qualitative data took seven days.

In the study, the mean scores obtained from the scale were taken as the basis for the analysis of quantitative data. Descriptive statistics such as the arithmetic mean, standard deviation, min, and max were used to calculate the 21st century skill levels of pre-service teachers. Since the scale used in the study is a 5-point Likert-type scale in the range of 1-5 points, the 21st century skill levels of pre-service teachers were divided into five levels. The Score Interval= (Highest score- Lowest score)/5 formula was used to determine the levels (Guvendi & Serin, 2019; Kaplanoğlu, 2014). According to this formula, the score range was determined as (5-1)/5=0.8. According to this calculation, regarding the 21st century skill levels of pre-service teachers, 1-1.79 mean score range was very low, 1.80-2.59 mean score range was low, 2.60-3.39 mean score range was moderate, 3.40-4.19 mean score range was high, 4.20-5.00 mean score range was very high. To determine the analyses to be made to find answers to the subproblems, it was checked whether the data showed a normal distribution. For this, skewness and kurtosis values for each variable in the sub-problem, as well as the results of Shapiro-Wilk and Kolmogorov Smirnov analysis, were examined. Since the skewness and kurtosis values were between -1.5 and +1.5 (Tabachnick & Fidell, 2013) and the significance level was higher than .05 (p>.05) in Shapiro-Wilk and Kolmogorov-Smirnov analyses, it was seen that the data showed a normal distribution. For this reason, parametric tests were used in the analysis. An independent sample t-test was used to determine whether the 21st century skill levels of pre-service teachers differed significantly according to the gender variable. An ANOVA test was used to determine whether the 21st century skills of the pre-service teachers differed significantly according to their GPA and the number of social activities they participated in. The Scheffe test was used to determine in which groups these significant differences occurred.

In the analysis of the qualitative data, content analysis techniques were used. Content analysis is expressed as a technique in which themes, categories, and codes are systematically created by using words or phrases to reflect the essence of the content in a text (Büyüköztürk et al., 2020). The main purpose of content analysis is to reach the concepts that can explain these data and the relationships between these concepts to explain the data obtained as a result of the interview (Yıldırım & Şimşek, 2018). The obtained data were transferred to the Microsoft Word document. These documents were transferred to the qualitative data analysis program, and content analysis was performed. The data in the document was divided into meaningful sections, and descriptive codes were given to these sections. In the next stage, the common aspects of these codes were determined and grouped under categories. After the codes, categories, and themes were created, the data were reviewed again. In this process, it was checked whether the codes were correct, and whether the themes were correct, whether the codes were under the appropriate theme, and accordingly, necessary corrections were made. The data from the interviews were presented in the findings section using frequency (f) and interviewee codes of I1, I2, I3, I26. The analysis of the interview data was carried out by two different researchers. After this stage, the percentage of agreement between the analysis results of the researchers was calculated (Miles & Huberman, 1994). As a result of this calculation, the percentage of agreement was determined to be 96%. After this process, the researchers came together, the findings were compared, and a consensus was reached on the inconsistent findings.

Findings

In this section, the findings obtained are presented. The descriptive statistics results related to the 21st century skill levels of pre-service teachers are shown in Table 3.

Variable	Sub-dimensions	Ν	Min	Max	$\overline{\mathbf{X}}$	Ss
	Information and Technology Literacy Skills	621	2.27	5.00	4.15	.50
Q 1 st	Critical Thinking and Problem-Solving Skills	621	1.00	5.00	3.99	.78
21 st	Entrepreneurship and Innovation Skills	621	1.40	5.00	3.49	.68
Skills	Social Responsibility and Leadership Skills	621	1.00	5.00	3.64	.66
SKIIIS	Career Consciousness	621	1.67	5.00	4.44	.58
	Total Mean Score of 21st Century Skills	621	2.63	5.00	3.96	.43

Table 3. 21st century skill levels of pre-service teachers

According to Table 3, it was determined that the 21st century skill levels of pre-service teachers ($\overline{X} = 3.96$) were at a high level. In addition, it was obtained that the 21st century skill levels of pre-service teachers in terms of information and technology literacy ($\overline{X} = 4.15$), critical thinking and problem solving ($\overline{X} = 3.99$), entrepreneurship and innovation ($\overline{X} = 3.49$), social responsibility and leadership ($\overline{X} = 3.64$) skills were at a high level, and career consciousness skill levels ($\overline{X} = 4.44$) were at a very high level. The findings regarding whether the 21st century skill levels of pre-service teachers differ in terms of the gender variable are given in Table 4.

Table 4. 21st C	entury Skill Lev	el of Pre-Service	e Teachers in Te	erms of Gender Variable
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Variable	Gender	Ν	$\overline{\mathbf{X}}$	S	sd	t	р
21 st Contury Shill	Male	262	3.94	.42	งาา	610	411
21 ^a Century Skin	Female	359	3.97	.43	022	019	.411

When Table 4 is examined, it is determined that the 21st century skill levels of pre-service teachers did not differ significantly in terms of the gender variable (p>.05). The descriptive statistics data of the 21st century skill levels of pre-service teachers in terms of the GPA variable are shown in Table 5.

Table J. 21 Century Skills of FIE-Service Teachers in Tennis of OFA varia	Table 5.	. 21 st	Century	Skills	of Pre-	Service	Teachers in	Terms of	f GPA	Variable
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Variable	Group	GAP	Ν	x	S	
	1	Less than 2.50	65	3.71	.47	
21 st Contury Shills	2	2.51-3.00	220	3.95	.44	
21 st Century Skills	3	3.01-3.50	291	4.01	.39	
	4	3.51-4.00	45	4.03	.48	

When Table 5 is examined, it is seen that there are differences in the 21^{st} century skill levels of pre-service teachers according to the GPA variable. The results of the analysis on whether these differences are significant are given in Table 6.

Table 6. The Change in 21st Century Skill Levels of Pre-Service Teachers in Terms of GPA Variable

Variable	Source of Variance	Sum o squares	f Degrees of freedom	Mean Squares	F	р	Difference
21 st	Between G.	4.715	3	1.572			1-2
Century	Within G.	11.941	617	.181	8.663	.000	1-3
Skills	Total	116.656	620				1-4
p<.05							

When Table 6 is examined, it is determined that the 21^{st} century skill levels of pre-service teachers differ significantly according to the GPA [F(_{3,617}) =8.663, p<.05]. According to Scheffe test results, it was concluded that the 21^{st} century skill levels of pre-service teachers whose GPA was between 2.51-3.00, 3.01-3.50, 3.51-4.00 were higher than those of pre-service teachers with a GPA below 2.50. Descriptive statistics data on the 21^{st} century skill levels of pre-service teachers in terms of the number of social activities they participated in are presented in Table 7.

Table 7. Descriptive Data on the 21st Century Skill Levels of Pre-Service Teachers in Terms of the Number of Social Activities Participated in Variable

Variable	Group	Number of Activity	Social	N	$\overline{\mathbf{X}}$	S	
	1	1		267	3.86	.44	
21st Contorn Chille	2	2		151	4.03	.41	
21 st Century Skills	3	3		100	4.02	.38	
	4	4 and above		103	4.05	.42	

When Table 7 is examined, it can be said that there are differences in the 21st century skill levels of pre-service teachers in terms of the number of social activities they participate in. The results of the analysis conducted to determine whether these differences were significant or not are shown in Table 8.

Table 8. The Change in 21st Century Skill Levels of Pre-service Teachers in terms of the Number of Social Activity Participated in Variable

	Variable	Source of	Sum of	Degree of	Mean	Б		Difference	
	variable	Variance	squares	freedom	squares	Г	р	Difference	
-	21 st	Between G.	4.574	3	1.525			1-2	
	Century	Within G.	112.082	617	.182	8.393	.000	1-3	
	Skills	Total	116.656	620				1-4	
* .	0 -								

*p<.05

It is seen that the 21^{st} century skill level of pre-service teachers differed significantly according to the number of social activities they participated in [F(_{3,617})=8.393, p<.05]. According to the Scheffe test results, it was determined that the 21^{st} century skill levels of pre-service teachers who participated in 2, 3, and 4 or more different types of social activities were higher than those who participated in only 1 type of social activity.

The opinions of pre-service teachers on the 21st century skills they think they have are given in Figure 1.



Figure 1. Acquired 21st century skills

As can be seen in Figure 1, pre-service teachers stated that they have learning and innovation skills, knowledge, media and technology skills, and life and career skills. Some sample quotations on pre-service teachers' opinions on this theme are given below:

112: "I think my problem-solving skills and communication skills are good. I am a social person and can handle problems more or less."

114: "I have social and cultural skills. I have friends in more than 20 countries. I know different cultures more than ever before."

I6: "I have entrepreneurship skills. I have an active personality. I have entrepreneurship and problem-solving skills in every business."

123: "I think I have communication skill. It is a necessity for me to be in contact with people due to the department I study, so I think my communication skills have improved."

121: "I think I have social and intercultural, media literacy, flexibility and adaptability, cooperation, and communication skills. Some are compulsory acquired skills. For example, the spread of the media has made it necessary for us to reach everything through the media."

114: "Media literacy, technology literacy, social, and intercultural skills. I have these three skills. Media literacy: I follow national and international news sources and informative websites. Technology literacy: I follow all kinds of technological devices. Games on PlayStation, upcoming cinemas, and newly released sites are my area of interest."

The opinions of pre-service teachers on the stakeholders responsible for enabling the students to acquire 21st century skills are shown in Figure 2.



Figure 2. Stakeholders responsible for enabling the students to acquire 21st century skills

Pre-service teachers stated that teachers, parents, academicians, the individual himself/herself, and bureaucrats are responsible for enabling the students to acquire 21st century skills. Some of the sample quotations on this theme are presented below:

111: "Heads of state, families, and teachers have responsibilities. The state should allocate a certain budget for people to acquire skills. Families and teachers should help them acquire these skills."
116: "It is necessary to enable the individuals to acquire these skills from infancy. For this, the family has the greatest responsibility, followed by the teachers."

119: "The greatest responsibility falls on the teachers. First of all, teachers need to have these skills. So basically, I think the greatest responsibility is in the faculties of education."

118: "Family members and teachers have responsibilities. Family members should try to ensure that their children adapt to the developing society. Teachers should help students know themselves and should pay attention to their interests and guide them."

12: "Universities have the main responsibility. They are environments that offer practice and implementation where these skills will be revealed. Individuals should be given the opportunity to explore these aspects of themselves with quality activities that are free from the anxiety of grades."
15: "Every development starts in the person himself/herself. If people want to change, they change."
17: "With a project carried out jointly by the Ministry of Technology and the Ministry of National Education, productivity can be increased to a higher level."

The opinions of pre-service teachers on the strengths of faculties of education in enabling them to acquire 21st century skills are shown in Figure 3.



Figure 3. Strengths of education faculties in the acquisition of 21st century skills

Pre-service teachers stated that the faculties of education have strengths in enabling them to acquire 21st century skills due to the academicians and the facilities of universities. Some of the responses on this theme are given below:

I20: "Adequate in terms of knowledge. Academicians who do their job right set the right example for us."

I24: "Faculties of education are very successful in providing these skills. An interactive learning environment is provided through social media."

118: "They are effective in acquiring skills such as entrepreneurship and self-management, cooperation, productivity, and accountability. For example, making presentations, giving group assignments."

112: "The faculty of education only increased my self-confidence in presentations. It also improved my communication skills as it provided a social environment."

12: "It offers opportunities for responsibility and self-management skills. Homework, community service practices, and internships pave the way for this."

I21: "They actively assign tasks to students. They teach by doing and experiencing the project assignments they give."

The opinions of pre-service teachers on the weaknesses of faculties of education in enabling them to acquire 21st century skills are shown in Figure 4.



Figure 4. Weaknesses of faculties of education in acquiring the 21st century skills

Pre-service teachers emphasized that faculties of education had weaknesses resulting from academicians, politics, and physical facilities in terms of enabling them to acquire 21st century skills. Some of the sample quotations on this theme are presented below:

116: "No event, program, or internship is arranged for us to practice our skills. That leaves the information hanging around for some of us."

120: "The biggest and most important deficiency is the academicians who do not apply the course they teach. For example, they talk about the constructivist education approach, but they conduct the classes with perennialism and essentialist understanding. They talk about democracy and freedom but humiliate the student. They do not tolerate different opinions. Unfortunately, there is a reality called academic arrogance."

I12: "Our faculty does little or no activity. This reduces interaction."

113: "I do not think that all academicians are at the same level. Some academicians have shortcomings."

I2: "Opportunities for the development of 21st century skills are not provided. These skills are overlooked as a more goal-oriented approach is adopted. This situation causes the education system to continue with the memorization system."

The opinions of pre-service teachers on the aspects of faculties of education that need to be developed to enable them to acquire 21st century skills are given in Figure 5.



Figure 5. Aspects to be developed by faculties of education in acquiring 21st century skills

Pre-service teachers made suggestions for academicians and policies in the context of acquiring 21st century skills. Sample quotations on this theme are presented below:

I3: "First of all, academicians should improve themselves by keeping up with the technology and the methods and techniques they use."

I2: "More social activities should be conducted within the course. There is a need for the implementation of process evaluation and project-based training. It is a must that rote understanding and grade anxiety be put in the background."

I5: "It would be better if students gained more learning outcomes related to life skills."

119: "More social events should definitely be organized. In addition to this, really useful elective courses should be offered that will increase self-confidence and initiative in students."

120: "Indeed, there is a need for teachers who believe in democracy, free thought, and human rights. There is a need for academics who are committed to finding solutions instead of criticizing and who will take responsibility for what they can do."

116: "Academicians should not just explain the skills to be gained by teacher candidates on theory; they should put them into practice. Within this, some internship applications or projects should be developed."

117: "It may be more beneficial for the faculty to be more open to technological developments and constantly update itself."

Conclusion and Discussion

In the study, it was examined whether the 21st century skill levels of pre-service teachers differ in terms of gender, GPA, and the number of social activities they participate in variables. In addition, the opinions of pre-service teachers were taken on the 21st century skills they think they have, the stakeholders responsible for enabling the students to acquire the 21st century skills, the strengths and weaknesses of faculties of education, and what needs to be done by these faculties. The findings suggest that pre-service teachers possess high levels of 21st-century skills. These skills include information and technology literacy, critical thinking and problem-solving,

entrepreneurship and innovation, social responsibility, leadership skills, and career consciousness skills. The study found that the pre-service teachers' levels of these skills were either high or very high. This implies that they may be well-equipped to meet the challenges and demands of the 21st-century workforce, which places a premium on these skills. In the literature, there are studies with similar findings. Aktas (2022) concluded that pre-service teachers' information and technology literacy, critical thinking and problem solving, social responsibility, and leadership skills, which are among the 21st century skills, were high, and career consciousness skills were at a very high level. Similarly, Canpolat (2021) found that pre-service teachers had high levels of information and technology literacy, critical thinking and problem solving, social responsibility and leadership, and entrepreneurship and innovation skills. In addition, there are studies with the findings that pre-service teachers had a high level of 21st century skills (Aydın & Tan Şişman, 2021; Bozkurt, 2021; Erten, 2020; Gömleksiz, Sinan & Döner Doğan, 2019; Kozikoğlu & Altınova, 2018; Özdemir Özden et al., 2018). However, unlike these results, there are studies with the findings that the entrepreneurial and innovation skills of pre-service teachers were at a moderate level (Aktas, 2022; Canpolat, 2021), and that their career consciousness skills were at a high level (Canpolat, 2021), which contradict the findings obtained in this study. Aktas (2022) states that the reason for the high career consciousness skills of pre-service teachers may be due to the "Career Planning" course being taught in the faculties of education. He emphasizes that with this course, pre-service teachers will have information about many professions, especially the teaching profession, and that their career consciousness can increase in this way. The reason for the high level of 21st century skill level of pre-service teachers obtained from the scale and its subdimensions may be due to the good qualifications of the academicians and their ability to conduct the teaching process effectively. As a matter of fact, pre-service teachers expressed the strengths of faculties of education in enabling them to acquire these skills as having academicians with good qualifications and providing quality education. In addition, another reason for the high 21st century skills of pre-service teachers may be due to the social activities they participate in. In the study, it was also found that as the type of social activity participated in increased, the 21st century skill levels of pre-service teachers also increased. This indicates that there is a positive correlation between participation in social activities and 21st century skills.

In the study, it was determined that the 21st century skill levels of pre-service teachers did not differ significantly in terms of the gender variable. This suggests that male and female pre-service teachers have similar levels of perceptions of the 21st century skills identified by the study. This is a positive finding, as it indicates that both genders are equally capable of acquiring these skills and that there is no inherent gender-based barrier that prevents individuals from developing these skills. Similar to the finding obtained from the study, there are studies in the literature in which the 21st century skills of pre-service teachers do not differ significantly in terms of gender (Aktaş, 2022; Bozkurt, 2021; Canpolat, 2021; Erten, 2020; Geçgel et al., 2020; Gömleksiz, Sinan & Döner Doğan, 2019; Kozikoğlu & Altınova, 2018; Özdemir Özden et al., 2018). On the other hand, Çevik and Şentürk (2019) found that the 21st century skills of male students were significantly higher than those of female students, which contradicts this study. In conclusion, the study suggests that pre-service teachers, regardless of their gender, possess high levels of 21st century skills. This is an encouraging result, as these skills are crucial for success in today's rapidly changing and increasingly competitive job market.

It was also obtained that GPA significantly affected the 21st century skills of pre-service teachers. Accordingly, it was concluded that the 21st century skills of pre-service teachers with high GPA were higher than those with low GPA. Similarly, in his study, Canpolat (2021) found that pre-service teachers with high GPA had higher 21st century skills than pre-service teachers with low GPA. In some studies, unlike the findings obtained in this study, it was determined that academic achievement did not significantly affect the 21st century skills of pre-service teachers (Geçgel et al., 2020; Özdemir Özden et al., 2018). The fact that pre-service teachers with high academic success also have high 21st century skills shows that in the education process the development of both academic success and 21st century skills is aimed. Moreover, it can be interpreted that the curriculum in the faculties of education aims to improve academic achievements and 21st century skills.

It was determined that the number of social activities participated in significantly differentiated the 21st century skills of pre-service teachers. It was determined that the 21st century skills of pre-service teachers who participated in 2, 3, 4, and above social activities had higher levels than pre-service teachers who participated in only one social activity. Based on the information given, it becomes evident that engaging in multiple social activities may have a positive impact on the development of 21st century skills among pre-service teachers. Therefore, encouraging pre-service teachers to participate in a variety of social activities may help them to enhance their 21st century skills. By incorporating project-based learning into pre-service teacher training programs, educators can provide opportunities for students to develop these skills while also gaining practical experience.

In the study, pre-service teachers stated that they have problem solving, communication, adaptability, flexibility, social and intercultural, information literacy, entrepreneurship, cooperation, leadership and responsibility, media

literacy, productivity, self-management, accountability, innovation, creativity, and technology literacy skills. This finding suggests that pre-service teachers possess a range of 21st century skills, which highlights the potential for pre-service teachers to be well-prepared for the demands of the modern workforce. These skills are also critical for success in many professions, and the fact that pre-service teachers possess them suggests that they may be well-equipped to meet the demands of their future careers. Additionally, this finding may suggest that pre-service teacher education programs are effective in developing these skills, which could have a positive impact on the future of education.

Pre-service teachers stated that teachers, parents, academicians, the individual himself/herself, and bureaucrats are responsible for the acquisition of 21st century skills. In the study of Bayrak Özmutlu and Ergan (2022), preservice teachers stated that the school and parents are responsible for acquiring 21st century skills. In the study of Karagöz and Dilekli (2018), university students stated that in addition to the teacher, the individual is also responsible for acquiring these skills. Cansoy (2018) stated that the primary responsibility for acquiring 21st century skills is in the family. He stated that by acting with this awareness, families should spend quality time with their children, guide them in line with their interests and curiosities, and act in cooperation with the school, In addition, he emphasized that community participation also contributes to the skill development of students. He also indicated that students could acquire content knowledge from different learning environments; therefore, it is necessary to make plans with different segments of society and to ensure that students learn by doing and experiencing. The findings obtained in this study and in the literature suggest that there is a need for collaboration and coordination among these different stakeholders to ensure that pre-service teachers are better equipped with the skills needed for the 21st century workforce. Teachers and academicians can play a significant role in providing the necessary training and education, while parents and the individual themselves can contribute to the development of these skills through their own efforts and attitudes. Bureaucrats and policymakers also have a responsibility to ensure that the necessary resources and policies are in place to support the acquisition of 21st century skills among pre-service teachers. By recognizing and acknowledging the shared responsibility among different stakeholders, it can lead to a more comprehensive and effective approach to improving pre-service teacher education and the acquisition of 21st century skills.

In the study, pre-service teachers identified the strengths of faculties of education in enabling them to acquire 21st century skills as good qualifications of academicians, providing qualified education, gaining self-management skills, teaching methods and techniques used in the teaching process, gaining responsibility skills, increasing self-confidence, providing detailed information, student-centered teaching, project-based teaching, providing social interaction, providing access to information, and providing social activities. They also stated that the faculty of education helped them acquire skills in problem solving, innovation, cooperation, productivity, accountability, and media literacy. In his doctoral study, Brown (2018) conducted research on two P21 sample schools, examining the best practices of 21st century skills in learning environments. In the study, it was found that in sample schools that provide 21st century skills, project-based studies are emphasized, measurement and evaluation are applied strongly, integration between school and society is ensured, technology integration is provided in the teaching process, and communication, cooperation, critical thinking, and innovation skills are strongly integrated into the curriculum (Brown, 2018).

In the study, pre-service teachers stated that the lack of practical activities, the lack of student-centered lessons, the arrogance of academicians, the over-responsibility, the lack of a democratic classroom environment, the ineffectiveness of some lessons, the inadequacies in the learning environment, the lack of social activities, the lack of qualified teaching staff, not having the same conditions in all faculties of education, the inadequacy of the opportunities offered, the lack of technology-supported education, and the lack of equipment were the weaknesses of the faculties of education in acquiring the skills of the 21st century. In addition, they stated that faculties could not develop skills such as flexibility and adaptability, productivity and self-management, media literacy, social and intercultural competence, and problem solving. It appears that pre-service teachers have identified several weaknesses in their education programs that impact their acquisition of 21st century skills. Therefore, it can be argued that there is a need for improvement in the faculties of education to ensure that pre-service teachers are better equipped with the skills needed for the 21st century workforce. In the literature, in various studies, the weakness of the faculties of education was stated by the pre-service teachers. In the study conducted by Aydın and Tan Sisman (2021), the pre-service teachers stated that 21^{st} century skills were not sufficiently included in the undergraduate education process and that the teaching provided was not qualified to provide these skills. Criticisms of faculties of education in Turkey that skill-based teaching approach is not adopted (Eret Orhan et al., 2017; Yüksel, 2015; Yurdakul, 2018) indicate that faculties of education are inadequate in providing 21st century skills. By addressing these weaknesses, faculties of education can help to ensure that pre-service teachers are prepared to meet the demands of their future careers and contribute to a more successful and innovative society. Finally, pre-service teachers made suggestions for the aspects of faculties of education that should be developed to enable the pre-service teachers to acquire 21st century skills. In terms of policy-oriented suggestions, they stated

that practical activities should be carried out, the conditions of the learning environment should be improved, the number of social activities should be increased, in-service training should be provided for academicians, cultural opportunities should be increased, these skills should be gained through elective courses, seminars should be given to students, the state should allocate a budget, and the entire society should be educated. In terms of the suggestions for academicians, they stated that technology compatibility with teaching methods should be ensured, processbased assessment and evaluation should be applied, project-based studies should be carried out, interaction in learning environments should be increased, the difficulty of the courses should be reduced, exams should measure high-level thinking skills, individualized education should be given, students' opinions should be respected, and academicians should be problem solvers. In addition, they stated that academicians should provide them with daily life, critical thinking, assertiveness, and self-confidence skills. Based on these findings, it can be said that there is a need for policy-oriented and academic-oriented suggestions to address the weaknesses identified in preservice teacher education. The policy-oriented suggestions indicate that improvements need to be made to the learning environment, the number of social activities should be increased, and practical activities should be carried out. In-service training for academicians and increased cultural opportunities can also play a role in improving pre-service teacher education. The academic-oriented suggestions suggest that there is a need for academicians to focus on ensuring that teaching methods are compatible with technology, process-based assessment and evaluation is applied, project-based studies are carried out, and interaction in learning environments is increased. Additionally, individualized education and measuring high-level thinking skills are important for the acquisition of 21st century skills. Academicians should also focus on being problem solvers and respecting student opinions. In the study of Bayrak Özmutlu and Ergan (2022), pre-service teachers stated that a problem-based teaching method should be applied and that drama, brainstorming, and discussion techniques should be used to acquire 21st century skills. In addition, pre-service teachers emphasized the need to integrate technology and art, cooperate with other institutions, and organize extracurricular activities. In the study of Bozkurt (2021), pre-service teachers stated that in order to acquire 21st century skills, teachers should be role models, skill-oriented courses should be included in the curriculum, it should be tested whether these skills are acquired, the hours of school experience lessons should be increased, and alternative assessment methods should be used. Erten (2020) found that in order for pre-service teachers to acquire 21st century skills, they should first of all gain information, technology, and media literacy skills; include different course contents and applications; determine what people's orientations are and provide training in this direction; and intensify practice-oriented studies. They also stated that activities such as courses, seminars, and conferences that will contribute to their development should be carried out. Overall, the implications of this finding suggest that there is a need for a comprehensive approach to improving pre-service teacher education. This includes both policy-oriented and academic-oriented suggestions, as well as a commitment from the entire society to ensure that pre-service teachers are better equipped with the skills needed for the 21st century workforce. By addressing these implications, faculties of education can help to ensure that pre-service teachers are prepared to meet the demands of their future careers and contribute to a more successful and innovative society.

Recommendations

In line with the results obtained from the study, the following suggestions can be made:

- In order for pre-service teachers to acquire 21st century skills, these skills should be integrated into the course contents, teaching processes, and curriculum in the faculties of education.
- Elective courses that can directly impart 21st century skills should be included in the curriculum of the faculty of education.
- The qualifications of pre-service teachers should be increased with in-service trainings to be provided to academicians who will carry out the teaching processes and be role models in acquiring 21st century skills.
- Since the acquisition of any skill cannot be the success of curriculum and academicians alone, pre-service teachers should make an individual effort to acquire 21st century skills. Pre-service teachers should participate in activities such as courses, seminars, etc., where they can use and develop these skills in daily life.
- Future studies can be carried out with pre-service teachers studying in different programs. Inferences about the 21st century skills of pre-service teachers can be obtained by carrying out studies specific to the program (for example, preschool teaching).

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Conflicts of Interest

There is no conflict of interest with any person in this study.

Ethical Approval

Ethical permission (E-21817443-050.99-233076) was obtained from Hatay Mustafa Kemal University Rectorate Ethics Committee.

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An Example Praxis for Teaching German as a Second Foreign Language with Augmented Reality Technology at Secondary Education Level

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An Example Praxis for Teaching German as a Second Foreign Language with Augmented Reality Technology at Secondary Education Level

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Abstract

The developments in technology bring to mind the questions of how the acquisitions and contents of the curriculum in the foreign language teaching process can be transferred to the students in a more effective and permanent way and which methods and technological opportunities can be used in the education process, revealing that different perspectives and different methods should be used. In this context, the aim of this study is to create an exemplary digital instructional design to be used in teaching German as a second foreign language with augmented reality technology at the secondary school level and to evaluate the effectiveness of this design through a pre-test, a post-test, and in line with the opinions of the students participating in the application. In order to achieve this aim, one group pre-test-post-test design, which is one of the experimental designs, was preferred. A dependent groups t-test was used in the analysis of the data obtained in the single-group pre-test post-test design. The research group for the study consists of 20 9th grade students at Turgut Reis Anatolian High School in Muğla. In the study, semi-structured interview questions were prepared in order to determine the opinions of the students participating in the application on the use of technology in German lessons at the secondary education level. Descriptive analysis was used to analyse the data obtained by the interview technique. As a result of the study, it was seen that there was a significant difference between the pre-test and post-test scores of the students. It has been concluded that the students in the course where digital content is used through VR glasses show more progress and are more successful.

Keywords: Foreign language teaching, German teaching, Technology, Augmented reality, Secondary education.

Introduction

Innovative developments are taking place in technology day by day. These developments in technology offer various opportunities to education as well as to many fields such as health, tourism, engineering and communication. Therefore, in the 21st century, which is characterised as the age of digitalization depending on the diversity and efficiency of the possibilities offered by technology, it is no longer about access to information because it is very easy to access information; the idea of how knowledge will be permanent is gaining importance. This situation reveals the necessity of using different perspectives and different methods in a permanent way in the education process in general, and in the foreign language teaching process in particular, by bringing to mind the questions of how the achievements and contents of the curriculum can be transferred to the students in a more effective way and which methods and technological opportunities can be used in the education process. Many methods have been tried in foreign language teaching, initially traditional methods and then alternative methods, and the search for methods still continues today (Yıldırım-Aksöz, 2013; Darancık, 2008). The continuation of the search for this method is an indication that the desired success in foreign language teaching has not been achieved. As a matter of fact, in many studies in the literature, it has been stated that foreign language teaching in Turkey is not successful at the desired level (Aktas, 2005; Balcı, 1997; 2012; Bayraktaroğlu, 2015; Karaman, 2016; Özdemir et al. 2017; Yılmaz & Yücel, 2020). This situation makes it necessary to evaluate and plan foreign language teaching from different perspectives, which is a comprehensive and multidimensional field that includes many emotional and cognitive factors, such as inadequacy of transferability to daily life, the curriculum, the student, the teacher, national language policies, methods, teacher competencies, teaching materials, cost allocated to foreign language teaching, learning situations, physical opportunities, families' attitudes towards foreign language, measurement and evaluation and mother tongue knowledge. In this context, integrating technology into the field, as the aim of this study is, can bring a solution in order to improve the foreign language teaching process and achieve the desired success. Thus, the effectiveness of education and training can be ensured by evaluating the

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opportunities offered by the current age with a different perspective on education and incorporating different technologies into this process. In the 2023 education vision, it is stated that digital content will be designed to support the development of language skills in the context of themes; and that opportunities will be provided for teachers to use digital resources for their qualifications and competencies (MEB, 2018, p. 69-70). As stated in the 2023 education vision created by the Ministry of National Education, the preparation of technology-based digital content in foreign language teaching has now become an indispensable need. With the development of technology, both the quantity and quality of technological opportunities in terms of serving different areas are also increasing. Different software, hardware, and devices are produced day by day. In addition, the interests and expectations of the target audience are not the same in every period, and the age at which they live is determinant in their interests and wishes. Depending on the changes in the stimulating environment and opportunities offered to the students by their current age, the way students acquire knowledge and skills may differ depending on the characteristics of the age in which they live. Digital environments will not be foreign to the Z generation, who were born in a digital world and have had many technological tools, especially smart phones, since infancy. Because the expectations of these students differed from the previous generations. Helmke (2009) considers the choice of method, taking into account the interests and expectations of the target audience, as a priority criterion in foreign language teaching, in order to convey the targeted content to the students. It is expected that the learning style of the Z generation, who grew up with technology, is widely technology and digital centred (Oblinger & Oblinger, 2005). Learning styles and forms may also differ depending on the changes in the areas that children growing up in the digital age enjoy and are interested in. Therefore, it is inevitable for educators to design learning environments with technological opportunities by taking this situation into account (Göçerler & Seyhan Yücel, 2021). Because, it is no longer possible to keep the interest and motivation of these students high with traditional methods, in which the method of presentation is at the forefront, by simply sticking to the textbook. Learning materials that have a higher sense of reality and perception compared to traditional course materials such as books or blackboards can also support the principle of proximity to life, which is one of the teaching principles, and contribute to the realisation of more effective and permanent learning. Therefore, with the inclusion of technological opportunities in foreign language teaching, the principle of proximity to life, which is one of the most important teaching principles, is also supported. The principle of proximity to life is reflected in the design of learning environments at school, which take their contents and materials from real life and select examples from natural life (Turan, 2019, p. 129). At this point, it becomes important to present the foreign language teaching designs to the students by associating them with real life. Because foreign languages have a feature that can be used in many aspects of life such as tourism, trade, international relations, hospitals, and markets, they are not considered a course that is only seen at certain hours and must be passed as planned in the curriculum (Karaman, 2018, p. 124). In other words, a foreign language, which is an abstract structure for the student, can be made more concrete and functional by finding a response in daily life. One way of embodying the abstract structure of a foreign language is the use of augmented reality technology in the foreign language teaching process. With this technology, it is possible to make the teaching programmes more functional. In this context, the concept of augmented reality is explained below.

Augmented Reality Technology

"Augmented reality is the live, direct or indirect physical view of the real world environment and its contents enriched with computer-generated sound, image, graphics and GPS data" (Büyükuygur & Güneş, 2018, p. 64). As Büyükuygur and Güneş stated, it is to strengthen the perception and understanding of the objects or environments in question by arranging and developing the real image of real objects or environments experienced by the person in real life in the computer environment. In other words, it is the enrichment of the objects or environments encountered in daily life through computers, some software, and hardware, and to serve education. Learning environments supported by augmented reality facilitate the process of acquiring skills, as this technology offers students the opportunity to gain experience (Punako, 2018). Augmented reality is beneficial to make the student feel as if they are in a real environment through a virtual environment, to create an experience different from the usual learning experiences, and to comprehend knowledge (Demirezen, 2019, p. 2). With this technology, the content is easier to remember because there is a learning environment in the form of a contextual pattern. 360degree videos are produced using special cameras with multiple wide-angle lenses. Unlike traditional videos, which offer a very restrictive perspective, 360° video provides a spherical view with multiple viewing angles and perspectives. In addition, the content of 360° video is in a versatile format and can be computer generated or captured from the real world, and as a result users can view everything within camera range, creating more interactive, immersive, engaging and realistic experiences (Lampropoulos, et al., 2021). In addition, 360° video can adapt to existing pedagogical approaches and due to its immersive qualities, students perceive their physical presence in a virtual environment and thus become more involved in learning activities (Rupp, et al. 2016). In addition, 360° video positively affects students' emotional reactions to the learning environment. Ulrich, et al., 2021). 360° video enhances the sense of immersion as it provides users with spherical views and enables them to

interact and communicate with the virtual world around them (Ranieri, et al.,2020) and they feel a sense of presence within them, through the illusion that experience surrounds them perceptually. Hodgson, et al., 2019).

With augmented reality technology, the language learning process is realised in a natural environment without being aware of it. As in the mother tongue learning process, it supports the learner to learn in a real and natural flow in life. Thus, the student will be able to comprehend the language without being aware of it and will see the linguistic inputs as abstract material. With this technology, learning situations are created from real-life environments by associating the content in the curriculum with real-life environments, and this environment is transferred to the formal classroom environment. For this, technological tools and equipment such as smart phones and virtual reality VR glasses are used. This technology not only embodies the achievements in real life, but also makes the teaching process more economical. Because it is more costly and more risky in terms of security to take students to places related to the content of the course by using the excursion technique. A more economical learning and teaching process will be experienced as these environments will be brought to the classroom with VR glasses instead of taking the students in large groups to environments where target achievements are experienced. Since this technological design appeals to the senses such as sight and hearing, learning and teaching environments are strengthened depending on the student's learning by experiencing the content. Another contribution of augmented reality is that this technology allows the student to feel as if they are in real life, and focuses on the knowledge and skills that are intended to be learned by abstracting from external factors that will distract the student (Roussou, 2004).

There is much research on the use of augmented reality technology in the worldwide (Kavanagh, et al., 2017& Pierson, 2001&Ranieri, et al., 2020& Rupp, et al., 2016 & Singhal, 2012). However in recent years, there have been some studies on the use of augmented reality in education in Turkey (Büyükuygur & Güneş, 2018; Değirmenci & İnel, 2020; Geriş & Tunga, 2020; İçten &Bal, 2017; Seçkin Kapucu & Yıldırım, 2019; Somyürek, 2014; Usta, et al. 2016). However, it is seen that most of these studies are in the form of theoretical and compilation (Kandemir & Atmaca Demir, 2020, p. 341). Therefore, it is seen as an important need to carry out applied studies that can be put directly at the service of teachers and students in schools and to develop instructional designs. In addition, while the studies on the use of virtual technologies in English teaching in Turkey are limited; (Kumkale & Adıgüzel, 2019, p. 230) no studies have been found in the literature on digital technologies such as the use of augmented reality in German teaching. The fact that technological tools (Kurt, 2014) clearly reveals this need in the field. In this context, in this study, a digital instructional design was created on a sample subject to be used in German teaching with an augmented reality application by integrating technology with German teaching.

As a result of the age at which students called Generation Z were born and grew up in different environments, their interest in virtual and digital objects differs from their teachers'. Students' interest in and desire for digital materials is higher than that of teachers. Therefore, the fact that teachers use only textbooks as teaching materials in the course is an ongoing problem for Turkey, which has not achieved the desired success in foreign language teaching. Depending on these technological opportunities offered by the age, the educational roles and duties of teachers have to be revised, restructured, and changed in accordance with digital transformation. One of these roles is the ability to be aware of technology and present these opportunities to teaching environments (Seyhan Yücel, 2020). Because there are inconsistencies between the learning styles of the students and the materials that will attract their attention, and the materials and stimuli adopted by the teachers and presented to the students. The inconsistency and conflict between the interests and wishes of the students and the teaching styles adopted and frequently used by the teachers take this process even further back. As a matter of fact, teachers who represent a higher generation compared to their students cannot understand the habits, interests, needs, and things they enjoy of the new generation that comes after them and grows up in different social textures (Uzun, 2012).

The Aim of the Study

The aim of this study is to create an exemplary digital instructional design to be used in teaching German as a second foreign language with augmented reality technology at the secondary school level and to evaluate the effectiveness of this design through pre-test and post-test in line with the opinions of the students that participated in the application. In order to determine the effectiveness of the digital instructional design developed at the end of the application, the efficiency of the digital content was evaluated in line with the opinions of the students using a semi-structured interview form consisting of six questions prepared by the researcher. In this context, the study consists of three stages. In the first stage, a German digital instructional design was created for the selected topic, in the second step, the instructional design was applied to the students in the school environment to determine the applicability of the developed digital instructional design; and in the third stage, the effectiveness of the German digital content was evaluated in line with the pre-test, post-test and students' opinions.

Method of the Study

Since both qualitative and quantitative data will be obtained in this study, a mixed method will be used. For this reason, the research is a mixed method research in which quantitative and qualitative research methods are used together. It is defined as an approach that includes the collection and analysis of qualitative and quantitative data, shapes it with theoretical foundations, and then combines the results obtained from the analyses for the purpose of understanding the mixed method research phenomenon (Creswell & Plano Clark, 2018).

In this study, one group pretest-posttest design, which is one of the experimental designs, was preferred. In this design, the researcher applies a pre-test to measure the dependent variable without interfering with the participants. The aim here is to measure the knowledge and skills level of the participants regarding the dependent variable. After the application, the final test is applied. Accordingly, a pre-test prepared by the researcher is applied to measure students' existing knowledge of the content intended in the instructional design. Afterwards, the posttest is administered after the instructional design is applied to the research group. In order to reveal the effectiveness of applications such as the curriculum, a conclusion is reached by considering the difference between the pre-test and post-test scores (Christensen, 2020, p. 258). Therefore, in order to measure the effectiveness of the digital instructional design developed in this study, an evaluation of the developed curriculum was made by calculating the results of the pre-test before the instruction and the post-test made after the instruction. In addition to the quantitative data obtained during the research, the study was also supported by qualitative data. Accordingly, the interview technique was used to determine the views of the students on the digital instructional design developed. Interviewing is a technique used to understand the experiences, feelings, thoughts, and attitudes of individuals towards a phenomenon or event (Yıldırım & Şimşek, 2008, p. 119). The effects of the German course, which was conducted using augmented reality technology with an interview technique, were investigated in line with the positive and negative opinions of the students. The ethics committee's approval of this study was obtained from the Social and Human Sciences Research Ethics Committee of a state university with the application numbered 210015.

Study Participants

In this study, 20 9th grade students studying at Turgut Reis Anatolian High School in Muğla were reached. The sample for the study was determined by the criterion sampling method, which is one of the purposeful sampling methods. Accordingly, some criteria were taken into account in determining the participants. These criteria are to be studying in the 9th grade at Anatolian High School, to be learning German as a second foreign language and to participate in the study voluntarily. At the beginning of the research, the participants were informed about the subject of the research, its purpose and the plans made regarding the implementation process.

Data Collection Tools

In this study, a pre-test was used to measure the knowledge of the students on the subject before the instructional design was applied; after the digital instructional design developed by the researcher was applied, three data collection tools were used: a post-test to measure the effect of the instructional design, and a semi-structured interview form to determine students' positive and negative views on digital content. The pre-test and post-test are two tests that reflect the achievements of the subject of "Einkaufen" (shopping) in the 9th grade German curriculum. They are prepared by the researcher and are similar in terms of the quality and quantity of the questions. At the end of the application, a semi-structured interview form is prepared to collect the experiences, thoughts and feelings of the students about the instructional design. This form consists of six questions.

Data Collection and Analysis

The data for the study were obtained face-to-face with the participants in the research group by using data collection tools and going to the school one-on-one by the researcher. A dependent groups t-test was used to analyse the data obtained in the single-group pre-test post-test design. The effect of the experimental procedure is obtained from the same participants with the same measurement tools, in the form of a pre-test before the application and a post-test after the application (Büyüköztürk, et al. 208). The t test is used to reveal whether the difference between the pretest and posttest mean scores is significant (Balcı, 2021, p. 250). The data obtained from the pre-test were analysed using the SPSS 22 package programme. Descriptive analysis was used to analyse the data obtained by the interview technique. The data obtained in the descriptive analysis are described and explained regularly (Sözer & Aydın, 2020, p. 267).

Digital Instructional Design Preparation Process

This study aims to develop a digital instructional design to be used in teaching German using augmented reality technology. In order to achieve this aim, first of all, the themes in the 9th grade German curriculum and the contents under these themes were determined, and the concepts expected to be learned for each content were determined. In the 9th grade German lesson, the "Deutsch für Gymnasien" book at the A1.1 level prepared by the Ministry of Education is used as a source. In this book, there are 8 themes: "Information zur Person, Schule, Die

Gesellschaft, Tägliches Leben, Essen und Trinken, Besondere Tage, Freizeitaktivitäten, Einkaufen" and 27 contents under these themes. In this study, "Einkaufen", one of the eight themes in the book, was chosen as an example and a digital instructional design was developed using augmented reality technology. The contents of "Kleidungen, Einkaufszentrum, Die Geschäfte, Online einkaufen" and the words related to this content were determined under the "Einkaufen" theme chosen for the implementation phase of the research. First of all, a reallife scenario about this subject was written by the researcher. In the scenario, there are four people: Esra and Cansu, who are two sincere girlfriends; a salesperson working in the store; and a cashier. In the scenario, two close friends, Cansu and Esra, talked on the phone the day before. Esra needs to buy a birthday present for a friend. In Esra and Cansu's phone call, Esra asks Cansu if she can come to the mall with her to buy a birthday present for the weekend, and Cansu tells her that she will come to the mall to accompany Esra at the weekend. In the previous telephone conversation, clothes names such as "Einkaufszentrum" (shopping mall), "Rock" (skirt), "Hemd" (shirt), and "Hose" (pants), which are among the learning inputs of "Einkaufen" (shopping), were used deliberately. The aim is for students to hear these concepts in advance and to create awareness about them. While the script was being edited, "Wie geht es dir?" (how are you?), "Was ist los?" (What happened?) and "Ich habe ein Problem." were used. By using expressions such as (I have a problem), the students' prior knowledge of previous subjects was also activated. Therefore, students will have the opportunity to learn different and short German expressions, as the scenario is created by taking into account a possible flow while shopping in daily life while the scenario is being fictionalised. In the continuation of the scenario, Cansu and Esra meet at the shopping centre at the weekend and go to a clothing store to look at the clothes. In this scene, these selected communicative expressions -Wie findest du das Hemd?, (How did you find the dress?) Ich finde das Hemd sehr schön." (I found the dress very beautiful) Was hat deine Freundin gerne an? (What does your friend like to wear?) "Sie hat gerne Rock, Hemd, Kleid, Bluse, Hose an." (My friend likes to wear skirts, shirts, dresses, and blouses.) Wie viel kostet diese Schuhe? (How much are the shoes?), Es kostet fünfzig. (Shoes 50 TL), Esra, kaufst du gerne Online ein? (Esra, do you shop online?)" are used. Thus, the daily life equivalents of the target acquisition "Student expresses herself in German in relation to shopping in general" were provided to be experienced by the students. Afterwards, we went to the shopping centre, where the subject took place, for the shooting of the script, and the shooting started. With Esra and Cansu meeting at the shopping centre, the shootings in the shopping centre begin, and they go to a famous clothing store known in Turkey. The scenario is played out in accordance with the scenario previously set up by the researcher. In order to get a clear image, the shots are repeated more than once and the most suitable recording is taken for the montage. Separately created recordings are combined in a certain flow, resulting in a video of approximately five minutes. This video has been finalised by supporting the elements added to the video later, such as visual designs, sound effects, written German expressions, and colouring, as in the structure of augmented reality technology. As a result, digital content was created depending on the achievements of the subject selected from the 9th grade German curriculum. The digital content was created from interesting fictions that overlap with everyday language usage, reflect the truth, and are suitable for the level and needs of the target student group. Through the digital content produced, care was taken to highlight a certain communicative.

Practice of the Developed Digital Teaching Design

In this study, the digital instructional design developed using augmented reality technology was applied to 9th grade students studying at Muğla Turgut Reis Anatolian High School. The application was carried out in the German course and took a total of two course hours. The subject of "Einkaufen" from the German textbook named "Deutsch für Gymnasien", which is at the A1.1 level of the Ministry of National Education, was covered in one class hour within the framework of the explanations and exercises in the book. The researcher explained the subject according to the flow of the course book, which she reflected on with the smart board available in the classroom, and the lesson was continued with exercises in the form of filling in the blanks. Therefore, the only teaching material in the first lesson was the textbook and the smart board.





In the image above, an example of the content of the "Einkaufen" subject in the book "Deutsch für Gymnasien, Schülerbuch Niveaustufe A1.1 to be used in German as a second foreign language lesson by the Ministry of National Education is given. As can be seen above, pictures of clothes such as trousers, shawls and skirts are given in this textbook, and a German dialogue has been prepared including the clothes in these pictures. According to the instructions in the book, this dialogue is first listened to from the audio file, and then the students are allowed to read it together with the teacher in the classroom. The flow in the book continues with the plural forms of the same clothes given in German, and finally, the students are asked a question about what the girl named Mia is wearing, and they are asked to mark the correct one from the image dressed in four different ways. The researcher applied the flow in the textbook as given as an example. After the lecture process was finished by the researcher, a pre-test was applied in order to determine the level of acquisition by the student of the learning outcomes of the course, which were based on the textbook. Afterwards, the lesson was interrupted for a week before the designed instructional design was implemented. After a one-week break, the second lesson hour, in which the developed digital instructional design was put to work, started. In this course, first of all, the participants were informed about how to do the application and the technological materials to be used in the course. VR glasses and smart phones were used as technological materials. Each student was given a VR glasses during the pre-preparation phase of the lesson. The prepared digital content was shared with the students via smart phones and transferred to the VR glasses given to each student. After the VR glasses were given to the students, it was observed that their interest in and desire for the lesson increased. The digital instructional design that students experience with VR glasses takes approximately 5 minutes. During the practise process, the students were watched twice because they wanted to experience the digital content more than once. When students put on VR glasses, they felt as if they had left the classroom and were in a shopping mall. Even though all students are in the classroom environment, external factors such as having an extracurricular interaction with their classmate, which creates a negative atmosphere that will negatively affect the learning environment, as each student experiences being in a different place with VR glasses, are avoided. Below is the digital content link and screenshots of this digital content. Digital content link: https://www.youtube.com/watch?v=oUp9XBFVyF8



As can be seen from the screenshot taken from the digital content above, two friends are looking at clothes in a clothing store, and they talk about the subject such as "ich kann Hose, Schal, Kleid, Rock und Hemd kaufen".

Photograph 2. A section from the shooting of the digital content scenario



As can be seen from the screenshot above, almost all possible life shopping situations in digital content have been animated and the abstract learning inputs have been embodied through the scenario. German expressions and linguistic uses in digital content are both voiced and written. Thus, students were able to experience both the pronunciation and writing of German expressions.

Photograph 3. An image from the application made with virtual glasses



Above is an image of the practice made with virtual glasses in the classroom environment. Students were able to experience the digital content that they could watch in three dimensions, regardless of the environment. Each student wearing virtual glasses had the opportunity to go out of the classroom and take a tour as if they were actually shopping in a shopping mall. Since the teaching process gains individuality after virtual glasses are put on, the possibility of experiencing other undesirable behaviors outside the classroom will be prevented. In this application, every student now has to focus on the content they encounter. Afterwards, a post-test was administered to the participants. Findings related to the study are presented below.

Findings

Normality Assumption

When the normality assumption, which must be met for the method to yield valid results, is examined, it is seen that the test results have a normal distribution according to the Shapiro-Wilk test in all combinations of the groups.

Photograph 1. A screenshot from digital content

	Shapiro-\	Vilk	
	Statistic	df	Sig
Pre-Test	,912	20	,069
Post-test	.944	20	,286

• For Pre-Test Scores: Statistic value= ,912; df=25; Significant Value= ,069

• For Post Test Scores: Statistic value= ,944; df=25; Significant Value= ,286

The assumptions of the dependent group t-test were tested in order to decide whether to use parametric tests in the tests related to the findings of the use of augmented reality application in German teaching. The first assumption is "Do the groups show a normal distribution?" For this, the Shapiro-Wilk test was used. When the table 1 given above is examined, p(pretest)=0.069>0.05; Since p(posttest)=0.286>0.05, it can be said that both groups are normally distributed. The second assumption is that the pre-test and post-test are administered to the same group of students, so it can be said that the groups are dependent. Since the above-mentioned assumptions were realised in the research, the t-test, which is a parametric test, was used for dependent groups in the comparison of the pre-test and post-test averages. The dependent group t test result is given in the table below. Accordingly, since p<0.01, it can be said that there is a high degree of difference between the pre-test and post-test.

 Table 2. Arithmetic mean, standard deviation and t-test results of pre-test and post-test scores

Measurement	Ν	Mean	S	t	р
Pre- Test	20	43,00	10,310	17,667	0,000
Post Test	20	69,50	9,986		

Statistical Evaluation of Pretest and Posttest Scores

As seen in Table 2, it was observed that there was a difference between the pre-test and post-test scores of the students. It was concluded that the post-test average score of the students was higher. It was observed that the difference in success in the post-test scores in the German course in which the instructional design developed using augmented reality technology was applied; was significantly higher than the difference in success in the pre-test scores in the textbook. According to these results, it has been determined that the students in the course where digital content is used through VR glasses show more progress and are more successful.

Evaluation of Student Views on the Practise

After the designed digital instructional design was applied to the participants, semi-structured interviews consisting of six questions were held in order to get the opinions of the students about the application. The interviews were analysed using the descriptive analysis method.

The data obtained in the study; including "positive and negative opinions about the German lesson using virtual glasses, the preference of teaching German lessons from the book in the traditional sense or using virtual glasses, the contribution of the use of virtual glasses to increase the interest and desire for German, other German subjects to be explained with virtual glasses, the virtual content to be catchy, and the wearing of virtual glasses to make you feel the reality" were grouped under six themes. These themes are schematized in the tables below.

Theme	Categories	Subcategories	F
THEME 1 Student	1.1. positive opinions	1.1.1. Effective	4
views on the German		1.1.2. More understandable	4
lesson used virtual		1.1.3. Good	7
glasses		1.1.4. Enjoyable	6
		1.1.5. A different app	3
		1.1.6. Productive	7

Table 3. Student views on the German lesson used virtual glasses

1.2. negative opinions	1.2.1. Glasses are headache	2
	1.2.2. An unnecessary app	3

Participants expressed positive opinions about the sample German lesson conducted using virtual glasses describing it as " - effective, more understandable than traditional lessons, nice, fun, efficient, and different in application. Two participants stated that glasses give them a headache, and three participants stated that they were an unnecessary application. In general, according to the opinions of the participants, it is understood that the use of augmented reality technology in German lessons has more positive effects on German teaching. Participants expressed their opinions as follows:

K1: "It was educational and fun. It was my first time using virtual glasses and I liked it."

K9: "I loved the German lesson we did using virtual glasses. It was a fun lesson."

K2: "I found the lesson with virtual glasses nice, but virtual glasses gave me a headache."

K16: "I found it nice, teaching using technology allows us to learn more."

As it is understood from the students' opinions given above, the virtual glasses used for the first time in the lesson are fun and instructive, the achievements of a German lesson integrated with technology are higher than the achievements of the German lesson, which is carried out with the textbook in the centre, but it was stated that wearing the virtual glasses for a long time causes headaches in the student.

Table 4. Preference for German lessons to be taught from a book or using virtual glasses

Theme	Categories	F
THEME 2 Preference for German lessons to	2.1. It should be told from the textbook	6
be taught from a book or using virtual glasses	2.2. Virtual glasses should be used	14

In the interview, the question "Do you prefer the German lesson to be taught from the book or using virtual glasses?" was asked. While 14 participants preferred to use virtual glasses in the lesson; 6 participants stated that they prefer to teach German lessons using books. Participants expressed their opinions as follows:

K2: "German lessons should be taught with virtual glasses. Because with virtual glasses, it is more memorable."

K3: "From the book, because wearing glasses all the time can spoil our eyes.

K7: "I prefer it to be told through virtual glasses. Because I find it beautiful, fun and educational."

K18: "I would like it to be done with virtual glasses. Because doing such things in the lesson makes me more interested in the lesson."

In general, the participants stated that they preferred the use of virtual glasses in German lessons because the content and achievements of the lesson conducted using virtual glasses are permanent, the lesson is fun, educational and interesting. On the other hand, 6 participants stated that they think that it is better to conduct the lessons from the book, citing that virtual glasses can negatively affect the health of the eyes.

Table 5. The contribution of the use of virtual glasses to the increase of interest and desire for German

Theme	Categories	F
THEME:3The	3.1 it contributed	13
contribution of the use	3.2. it did not	7
of virtual glasses to the	contributed	
increase of interest and		
desire for German		

13 participants stated that the use of virtual glasses in German lessons contributed to the increase of their interest and desire for learning German; on the other hand, 7 participants stated that virtual glasses did not contribute to their interests and wishes regarding the German course. Participants expressed their opinions as follows.

K3: "Yes, my interest has increased, now I remember what I saw in virtual glasses in German lessons".

K11: "No, because I am already interested in German".

K6: Yes. The experience of using virtual glasses in German class was nice."

As it can be understood from the statements above, it was emphasized that the digital content watched through virtual glasses is easier to remember, thus increasing the motivation of the participants to learn German. From the opinions of the participants, it is understood that the use of virtual glasses has a positive contribution to the students' interest in and desires for German.

Table 6. Explaining other German subjects with virtual glasses

Theme	Categories	F
THEME 4. Explaining	4.1.Yes	12
other German subjects		
with virtual glasses	4.2. No	8
with virtual glasses	4.2. No	8

In another question, the participants were asked whether they wanted other German subjects to be explained with virtual glasses as well. While 12 participants gave a positive answer to this question, 8 participants gave a negative answer. Participants expressed their opinions as follows:

K2: "Yes, I would like other German subjects to be explained with virtual glasses. Because, thanks to visuals, memorability increases."

K5: "No, I don't would like. Because glasses hurt my eyes."

K9: "I would like to, because virtual glasses are better, more interesting and more fun than the board and the book."

In terms of positive aspects such as the presence of visual content in virtual glasses that is interesting and fun, based on the above statements, the participants wanted other subjects of German to be explained with virtual glasses; however, it is understood that they do not want this method to be used in the teaching of other subjects since the glasses hurt the eyes.

Table 7. To be memorable of virtual content

Tuble 7: 10 be memorable of virtual content			
Theme	Categories	F	
THEME 5. To be	5.1.memorable	14	
memorable of virtual content	5.2. not permanent	6	

As it can be understood from the table above, 14 participants stated that the digital content is permanent and 6 participants expressed their thoughts that it is not permanent. Participants expressed their opinions as follows:

K 7: "Yes, because I watched it with virtual glasses."

K14: I think it's catchy because it's attractive, so it's easier to remember."

K1: "It was not catchy in my opinion because it was difficult to understand because our German level was not good."

The majority of the participants supported the catchy nature of digital content as virtual glasses attract their attention; the participants, who thought that the digital content was not catchy, attributed this negative opinion to their poor level of German.

Table 8. The feeling of reality by wearing virtual glasses

Table 6. The feeling of fee	inty by wearing virtual glasses	
Theme	Categories	F
THEME 6 The feeling	6.1.Yes	12
of reality by wearing virtual glasses	6.2. No	8

In another question, participants were asked whether they felt like they were watching digital content in the shopping mall when they wore the virtual glasses. 12 participants stated that they felt like they were in a real

environment when they watched digital content; 8 participants stated that the feeling of being in the real environment did not occur. Participants expressed their opinions as follows:

K19: "I felt like I was shopping. Because it was a real environment that we watched through glasses." K1: "I felt it. Because it was three-dimensional."

K9: "No, I didn't feel it because there was noise in the classroom."

As it can be understood from the statements of the participants above, it is understood that the participants felt as if they were having an experience in real life, for reasons such as shooting digital content in a real environment and being three-dimensional. Therefore, it can be said that digital content creates a perception of reality.

Results and Discussion

In this study, an exemplary digital instructional design was created to be used in teaching German as a second foreign language with augmented reality technology at the secondary education level. It was applied in the 9th grade at Anatolian High School, and the effectiveness of this design was evaluated in line with the pre-test, posttest, and students' views on the digital instructional design developed by the researcher. In order to determine the effectiveness of the instructional design in the research, the students were first given a pre-test before the application, and then the 9th grade students were taught German with the instructional design prepared using augmented reality technology. At the end of the practise, a post-test was administered to determine the effectiveness of the application. It was observed that the difference in success in the post-test scores in the German course in which the instructional design developed using augmented reality technology was applied was significantly higher than the difference in success in the pre-test scores in the German course taught using the textbook. According to these results, it has been determined that the students in the course where digital content is used through VR glasses show more progress and are more successful. In many studies, it was concluded that the academic achievement of students increased as a result of interactions with VR technologies (Bacca, et al., 2014 & Chiang, 2014). In addition, it was concluded that the post-test arithmetic mean score of the students was higher than the pre-test arithmetic mean score. In the study, not only quantitative data but also qualitative data were obtained. In a study conducted in Switzerland on the usability of augmented reality technology in the classroom environment, it has been shown that augmented reality technology products can be used without restricting the class in other courses and or hindering the teaching of the course (Cuendet, et. Al., 2013). Therefore, after the designed digital instructional design was applied to the participants, semi-structured interviews consisting of six questions were conducted in order to get the opinions of the students about the application. According to the findings obtained from these interviews, positive opinions were expressed that the use of virtual glasses in German lessons is fun, instructive, effective, more understandable than traditional lessons, and that it is a beautiful, efficient, and different application; it was also stated that wearing virtual glasses for a long time causes headaches and eve deterioration in students. The course may have been evaluated as enjoyable and instructive by the students, since they generally use virtual glasses while playing digital games in their social lives and the digital content is shot in a real environment. The fact that long-term exposure to glasses can negatively affect the student' health can be considered a negative effect of this practise.

The majority of the participants stated that virtual glasses make digital content more appealing because they attract their attention. It can be said that digital content increases the motivation for learning German, since digital content watched through virtual glasses is easier to remember. In the study on the effect of augmented reality on the motivation of students at the secondary school level in Spain, it was concluded that students' attention, interest, confidence and satisfaction towards the lesson increased (Di Serio, et al.,2013). While the participants stated that they wanted other subjects of German to be explained with virtual glasses, they stated their reasons as having visual content in virtual glasses, being interesting, and being entertaining. Therefore, not only in 9th grade German teaching, it can be concluded that augmented reality technology can be used at other school levels as well. Because the participants stated that they would prefer to use virtual glasses in German lessons because the content and achievements of the lesson conducted using virtual glasses are permanent and the lesson is fun, educational, and interesting. Educational virtual reality applications help students increase their learning performance (Lin et al., 2013).

Another result of the study is that the participants felt as if they were having a real-life experience, due to the fact that the digital content was shot in a real environment and is three-dimensional. Therefore, it can be said that the application of augmented reality contributes to the association of the abstract foreign language teaching process with real life by embodying it, and accordingly, the language has become a structure that has a function in real life, rather than just a set of passive rules. Since the teaching activity, which is traditionally carried out by adhering only to the textbook, does not enable the student to acquire the achievements by experience, the content given to the student remains only in short-term memory, and the information cannot be transferred to the long-term

memory because the student cannot experience enough experiences regarding the course content in this process, therefore, full learning cannot take place. In this context, the use of augmented reality applications in German teaching can provide important contributions to the teaching process.

The second foreign language teaching process should be supported by including technological opportunities in the teaching process instead of the German lessons being only textbook-centered as in the traditional foreign language lessons.

Having technological devices such as computers and smart boards in schools is not sufficient for teachers to use this technological infrastructure. In order to serve this technological education, it is an important requirement to provide training to educators so that they can integrate pedagogical and field knowledge with the opportunities provided by technology (Bostancioğlu, 2017: 93). Therefore, in-service training within the scope of TÜBİTAK projects should be organised for teachers regarding the use of technology in German teaching. Considering the methods, techniques, and teaching materials used in the teaching process and the opportunities offered to generation Z by the environment in which they were born and grew up, digital content should be presented to them depending on the change in their interests and desires.

Ethical Approval

Ethical permission (05.11.2021) was obtained from the Social and Human Sciences Research Ethics Committee of a state university with the application numbered 210015.

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