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Digital Game Addiction from The Perspective of Children Aged 10-14 Years: A Phenomenological Research

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Abstract

The study aims to explore digital game addiction from the perspective of children aged 10 to 14, focusing on the impact of digital games from their perspective. To do this, the phenomenological research design, using qualitative research methods, was employed. Criterion sampling, one of the purposeful sampling methods, was administered to select participants. Data was collected via individual interviews with 24 children, and interview transcripts were analyzed using content analysis techniques. Findings showed that the majority of children equated digital game addiction to substance addiction. Children explained that digital games cause addiction because of several factors, such as completing missions, winning the game, passing to the next level, and being entertained. The study concludes that digital games affect children academically, socially, physically, and psychologically. Children with high addiction scores to digital games highlighted the effect of digital games on the increasing tendency to violence, while children with low addiction scores to digital games indicated the entertainment aspect of the games in terms of psychological aspects. It was determined that social isolation and the disruption of family relationships become prominent in the effects of digital games on children's social lives. Furthermore, children stated that digital games cause skeletal and muscular system disorders and weight gain, and they mostly stated eye diseases among the physical effects of digital games.

Keywords: Children, Digital addiction, Digital game addiction, Phenomenology

10-14 Yaş Arası Çocukların Gözünden Dijital Oyun Bağımlılığı: Fenomenolojik Bir Araştırma

Öz

Bu çalışma, 10-14 yaş aralığındaki çocukların gözünden dijital oyun bağımlılığını keşfetmeyi ve dijital oyunların etkisine odaklanmayı amaçlamaktadır. Çalışmada nitel araştırma yöntemlerinden fenomenolojik araştırma deseni kullanılmıştır. Katılımcıların seçiminde amaçlı örnekleme yöntemlerinden ölçüt örnekleme yöntemi kullanılmıştır. Veriler 24 çocukla yapılan bireysel görüşmeler yoluyla toplanmış ve görüşme kayıtları içerik analizi teknikleri kullanılarak analiz edilmiştir. Bulgular, çocukların büyük bir kısmının dijital oyun bağımlılığını madde bağımlılığına benzettiklerini ortaya koymuştur. Çocuklar dijital oyunların eğlenceli olma, oyunu kazanma, görev tamamlama ve bir sonraki seviyeye geçme özellikleri nedeniyle bağımlılık yaptığını belirtmişlerdir. Çalışma dijital oyunların çocukları akademik, sosyal, fiziksel ve psikolojik yönden etkilediği sonucuna varmıştır. Öte yandan, bağımlılık puanı yüksek olan çocuklar dijital oyunların psikolojik açıdan en çok şiddet eğilimlerini artırma etkisinden bahsederken bağımlılık puanı düşük olan çocuklar ise eğlendirme etkisini dile getirmişlerdir. Dijital oyunların çocukların sosyal yaşamlarına etkisinde sosyal ortamdan uzaklaşma ve aile ilişkilerinin bozulmasının öne çıktığı tespit edilmiştir. Çocuklar dijital oyunların fiziksel etkilerine yönelik en çok göz rahatsızlıkları dile getirmekle birlikte kilo alma ve iskelet-kas ağrılarına sebep olduğunu da belirtmişlerdir.

Anahtar kelimeler: Çocuklar, Dijital bağımlılık, Dijital oyun bağımlılığı, Fenomenoloji

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INTRODUCTION

Information and Communication Technology (ICT) tools have rapidly become increasingly prevalent with their developing features and increasing usage areas. Turkey also has a significant level of Internet access. According to the survey on ICT usage in households, the proportion of households accessing the Internet in 2021 is 92%. (Turkish Statistical Institute [TURKSTAT], 2021). It is seen that children mostly use the Internet and ICT tools for entertainment and playing games (Kaşıkçı et al., 2014; Turgut & Kurşun, 2020; RTÜK, 2016). Ergüney (2017) points out that children use the Internet for various purposes, especially for watching cartoon films and playing games beginning at the age of three. Toran et al. (2016) have reported that the age of playing games and watching videos in digital media has decreased to 1-1.5.

In the literature, studies show that digital games have many cognitive, social, and emotional contributions to individuals. They benefit from ensuring hand-eye coordination and improving multitasking skills (Lin & Hou, 2015). Besides, children also might improve their social aspects in multi-user digital games by chatting with their friends (Aslan et al., 2019). Digital games can also improve gamers' abilities, such as analyzing, solving problems, reasoning, and making decisions (Kim & Smith, 2015). Digital games are also used in foreign language education to facilitate vocabulary learning (Ceylaner & Yanpar Yelken, 2017). They also improve their visual literacy and provide skills needed in some professions, such as pilots (McKinley et al., 2011).

Besides the positive effects of digital games that children mostly prefer for entertainment, digital games can cause several academic problems, such as refusing to go to school, their reluctance to attend classes, lower academic success, forgetfulness, and sleeping in class (Gentile, 2009; Karacaoğlu, 2019; Odabaşıoğlu et al., 2007). It is seen that some children prefer to socialize in digital game environments, and they have a problem initiating and managing communication in real life (Kowert & Oldmeadow, 2013). Therefore, children become less involved in the group of friends and have conflicts with their family members (Gülçek, 2018). Strategy games confuse children's inner worlds and desensitize them by triggering only the sense of winning (Budak, 2017). Exposure to violent scenes in digital games may normalize violence for children, leading to desensitization towards violent behaviors (Balıkçı, 2018). Consequently, this desensitization may prompt children to adopt violence as a solution to everyday challenges (Budak, 2017; Tutkun et al., 2017). Additionally, digital games are linked to various physical health issues, including headaches, disorders of the skeletal and muscular systems, epileptic seizures, and dry eye syndrome (xerophthalmia) (Griffiths & Hunt, 1998; Horzum, 2011). Moreover, there is an increased risk of obesity among children who engage in more than five hours of digital gaming daily (Berber et al., 2014).

Literature Review

Individuals experience various periods according to their mental, physical, psychological, and social developmental stages. The 10-14 age range is also a period that can be characterized as late childhood or early adolescence (Ertuğrul & Eker, 2019). In the relevant period, children pass from the concrete operational stage to the abstract operational stage and reach a level of maturity close to adults by developing their hypotheses, problem-solving, reasoning, and abstract thinking abilities (Doğan, 2007; Özbay, 2004). Children at this age experience rapid physical growth, such as height and weight gain, development and coordination of muscle and skeletal systems, and maturation of vision (Doğan, 2007; Koç, 2004). Despite having a physically young individual appearance, the quality of social relations of children who experience psychological confusion with their childlike aspects in this age range changes (Blum et al., 2014; Ünalan et al., 2007). It is seen that the socialization process that starts with the family at an early age has shifted to the school environment and friend groups. Gaming is an important activity that ensures children's mental, physical, psychological, and social development (Özer et al., 2006). Instead of playing games with their friends in the schoolyard or on the street, children are inclined to play digital games with the rapid development and spread of information and communication technologies. The long-term use of digital games, which is at the forefront of children's internet activities, causes addiction. Indeed, Mustafaoğlu and Yasacı (2018) have reported that 87.1% of parents think their children are addicted to digital games. Along with digital game addiction, there are various cognitive, physical, and behavioral problems, such as playing games uncontrollably, increasing in-game time, getting anger blocked, ignoring school and social life responsibilities and family relationships, and eating and sleeping disorders (Cham et al., 2019; Horzum et al., 2008). Some studies have reported that digital game addiction has a positive relationship with factors such as anxiety (Karaca et al., 2015), depression (Baş, 2018), social anxiety and low self-esteem (Rooji et al., 2010), anger management, and tendency to violence. Studies also show that more and more children are addicted to digital games. (King et al., 2013; Kuss & Griffiths, 2012). It has been recently observed that digital game addiction causes

incidents resulting in theft, crime, and suicide (Odabaşıoğlu et al., 2007; Ögel, 2012; Yücel & Şan, 2018). In addition, due to digital game addiction is seen that children avoid socializing and have problems with family connections (Kim et al., 2008).

Parents find it difficult to supervise their children's in-game time with digital games and the widespread use of smartphones, tablets, and laptops. This increases the risk of children's digital game addiction (Aksel, 2018). Although children's time on the Internet and digital media is considered worrying by their parents, they may be within normal limits. In addition to the perspectives of children and their parents, who are members of different generations, towards digital devices and digital games, their perception of digital game addiction is also different (Eşgi, 2013). Therefore, identifying children's perceptions and awareness of digital game addiction is important to understand parents' concerns. When literature is examined, studies have been carried out on children's digital game addiction levels and the positive and negative effects of digital games on children (Karagöz, 2017; Mustafaoğlu & Yasacı, 2018). Wan and Chiou (2013) indicated that studies on digital game addiction are generally conducted based on quantitative data aimed at explaining the behavior of addicted users. Similarly, in Turkey, there are also quantitative studies that analyze the level of children's digital game addiction and its effect on their social life and academic success (Torun et al., 2015), its relationship with violence and aggression (Aydoğdu Karaaslan, 2015; Dolu et al., 2010), its effect on the level of loneliness (Çakır & Oğuz, 2017; Öncel & Tekin, 2015) and its relationship with communication (Yılmaz & Biricik, 2017). There are very few studies that examine the relationship of digital game addiction with violence and aggression (Özkan & Hira, 2017; Tutkun et al., 2017). In brief, both international and national studies have largely conducted research on the status and impacts of children who are addicted to digital games. However, in order to understand how addiction develops in children, it is vital to examine the digital game behaviors of both children with high addiction scores (CHAS) and children with low addiction scores (CLAS). Indeed, since children might hide the games they play on mobile devices, children's digital gaming behavior should be analyzed in depth through phenomenological studies (Gökçearslan & Seferoğlu, 2016). In another study, it is emphasized that there is a need for detailed studies to reveal the reasons for children's digital game addiction (Ministry of Health, General Directorate of Health Promotion [MHGDHP], 2018). Understanding how children aged 10 to 14, a critical developmental period, perceive digital game addiction will offer valuable insights for preventing and addressing this risk. Indeed, no in-depth study has been found in Turkey that shows how children between the ages of 10 and 14 are affected by digital games and how they perceive digital games and digital game addiction. The current study aims to reveal digital game addiction from children's perspective between the ages of 10 and 14 and how they are affected by digital games. In line with this purpose, the following research questions below were formulated:

1. How are the digital game habits of CHAS and CLAS to digital games?
2. What does digital game addiction mean for CHAS and CLAS to digital games?
3. How do digital games affect children who are/are not addicted to digital games?

METHOD

The phenomenology research design was preferred in this study to determine how children between the ages of 10 and 14 perceive the phenomena of digital games and digital game addiction. It is important to perform phenomenological analysis to develop datasets and provide a comprehensive definition of the phenomenon (Yüksel & Yıldırım, 2015). Phenomenological studies focus on how participants make sense of a phenomenon through their points of view (Johnson & Christensen, 2014). Digital games are a phenomenon that is preferred and are played by many children and causes addiction to some of them; however, there is no in-depth information about how children make sense of them and how they explain it (Şimşek & Karakuş Yılmaz, 2020)

Research Design

Participants

Data sources in phenomenological research are individuals who have directly experienced the phenomenon under investigation (Yıldırım & Şimşek, 2008). The data source of this study is also children between the ages of 10 and 14 being the addressees of digital game addiction. The criterion sampling method, one of the purposeful sampling methods, was used to select participants. This method aims to study all situations providing a predetermined set of criteria (Yıldırım & Şimşek, 2008). For the selection of the sample, having a high addiction

score and a low addiction score were determined as the main criteria. Within this context, a secondary school in Türkiye's province with a moderate socio-economic level was visited. Children who met the criteria set in this secondary school were informed about the study. The parental consent form was given to 51 children who volunteered to participate in the study. The children of 43 parents who signed the consent form for their children to participate in the study were included. The 24 children included in the study were coded F6H1, M8L2, etc. (Appendix 1). The codes are designed to represent as F6H1 code, F(Female), 6 (Grade 6), H (High Addiction Score), 1 (Participant No. 1) and M8L2 code M (Male), 8 (Grade 8), L (Low Addiction Score),2 (Participant No. 2). Information on gender, grade level, age and digital game addiction levels of the participant children is presented in Appendix1.

Data Collection

The scale Hazar and Hazar (2017) developed was used to determine children's digital game addiction levels. As a result of factor analysis conducted in the scale development process, a structure consisting of the Cronbach alpha coefficient of 0.91 and 24 items and four factors were obtained. These four factors are “excessive focus and conflict towards digital gaming”, “development of tolerance in duration of playing and the value of the game”, “postponement of individual and social tasks”, and “psychological-physiological reflection of deprivation and being hooked on digital games”.

A semi-structured interview form was developed to reveal children's digital game habits and perceptions of digital game addiction and how they are affected by digital games. Firstly, a draft interview form with 12 questions suitable for the research was prepared. Additionally, arrangements for interview form were made in line with feedback received from two field experts working on digital game and digital game addiction. A pilot study was conducted with eight children, a girl, and a boy, from each grade level at secondary school. According to the findings obtained from the pilot study, the interview form was finalized by adding probes to one question.

Data Analysis

The necessary permission was taken from the institution for a scale study to be carried out with children within the scope of the study. Accordingly, the study's data collection process was carried out between February and May 2019. At first, children at schools were informed about the study within the framework of research ethics. After the children had been informed, the parents whose children wanted to participate were given permission. Scores they received from the scale developed by Hazar and Hazar (2017) formed a basis for determining their addiction level. Children can score between 1 and 120 on the scale. In this study, children who scored between 1 and 72 on the scale were considered CLAS, and children who scored between 73 and 120 were considered CHAS (Hazar & Hazar, 2017). The information on the addiction scores of the participants is presented in Appendix 1.

After the scale study was carried out with 43 children, individual interviews were conducted with the children. During the interviews, the children were not informed about the scores they received from the scale and about their addiction status. In order to prevent data loss and save time, interviews were audio-recorded with the participant's permission. Content analysis was performed after the voice recordings were transcribed. The content analysis increases the comprehensibility of the researched phenomenon with the process of data combination by coding data and collecting them under certain themes (Elo & Kyngäs, 2008). In this process, as Karasar (2009) stated, data were coded by the first researcher by considering the purpose of the study and without being detached from the context of the study. Other researchers checked the coding and made arrangements. Temporary themes were created by evaluating the answers given for each question. Intersecting themes were determined and gathered under the same theme, and a code-theme relationship was established. Within the scope of the study, the findings obtained from the interviews were examined, and feedback was received from the field experts. Based on the received feedback, 24 children were included in the study by considering the focus of the study, the amount of data, and the theoretical sampling, which are the three basic principles put forward by Yıldırım and Şimşek (2008) to determine the sample size in qualitative research. With the data obtained from the individual interviews with children, the data depth has been reached in a way that does not cause data repetition. The findings obtained from these data were tabulated to the research questions and presented by direct quotations.

Studies of Validity and Reliability

Due to the preference for a phenomenological pattern, which is one of the qualitative research methods in this study, the strategies by Lincoln and Guba (1985), such as credibility, transferability, dependability, and confirmability, were adopted in order to ensure reliability and validity (as cited in Yıldırım & Şimşek, 2008).

Credibility

- In developing the interview form, opinions from two field experts on Computer Education and Instructional Technology (CEIT) were obtained.
- The pilot study for the interview form was conducted with eight children, one girl and one boy from each grade level.
- While preparing the interview form, a theoretical framework was considered the pattern, and the adequacy of the data obtained to answer research questions was considered.

Transferability

- All phases of the study were explained in detail.
- A criterion sampling method was used to reflect the research topic for the sample selection.
- The raw data were arranged according to the themes revealed and detailed by direct quotations.

Dependability

- All findings of the study were supported by raw data.
- During the interviews, questions were asked of the participants in the same order, and expressions that would affect their opinions were avoided.
- The relationship of research results with research questions was considered.

Verifiability

- Interview data, findings and comments, coding, and themes were noted and were repeatedly controlled.

Research Ethics

In this study, the rules of scientific research and publication ethics were followed in all research processes. Students were given detailed information about the purpose of the study. The student's participation in the study was voluntary, and written permission was obtained from the student's parents before participation. The student's personal information was kept confidential and was not shared with third parties in any way.

FINDINGS

Digital Gaming Habits

This study examines children's digital gaming habits in terms of games and types of games played, digital devices used for digital gaming, digital device ownership, in-game time, and children's age to start digital gaming. Findings related to the children's age to start digital gaming are presented in Figure 1.

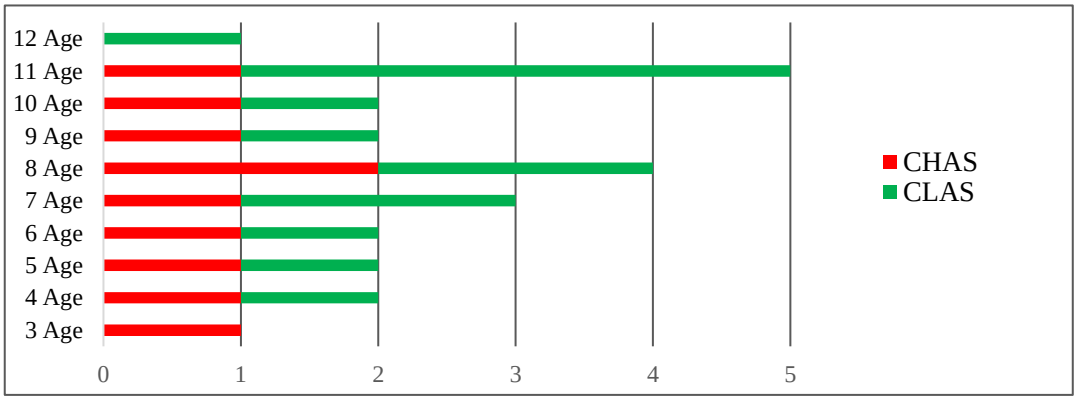

Figure 1. *Children's age to start digital gaming*

As illustrated in Figure 1, the age of starting digital gaming changed between 3 and 12. Participant M6H1, who started playing digital games at an early age, expressed, "When I was two years old, we visited our grandparents. They had a computer. I wanted to play computer games. My father bought me a computer when I

was three years old. I have been playing since I was four years old. "However, it was found that addiction is less common in children who started gaming after nine years old. Participant F7L5, who is CLAS, expressed the age of starting digital gaming, "I started playing games at the age of nine. It was forbidden for me to play on the phone. One day, my brother played games when I was bored at home. He told me to come and play together."

The digital device ownership and which digital devices children play are presented in Table 1.

Table 1. Digital Game Devices Played by Children

Devices	CHAS		CLAS	
	Personal	Co-user	Personal	Co-user
Smartphone	8	3	8	3
Computer (desktop/laptop)	4	5	6	3
Tablet	7	1	3	1
Console	2	1	4	1

*Children can answer more than one regarding the game device they use

As demonstrated in Table 1, smartphones are placed at the top among devices children prefer to play digital games, and computers and tablets follow it. It was observed that the condition of having ICT tools by children is at a considerable rate. It was observed that while almost all CHAS have at least one digital device, some of the CLAS have none. Participant M8H6 expressed, “My smartphone, tablet, and laptop belong to me. We use the console with my brother.” Besides, participant F7L18, who hasn’t got any device, expressed, “I use my cousin’s computer, my mother’s phone, and the PlayStation at the internet cafe.”

Children's preferred ICT tools for playing digital games and the frequency of playing digital games vary. The frequency of digital gaming according to having a high addiction score or low addiction score is presented in Table 2.

Table 2. Children’s In-Game Time (Weekly)

Frequency of Digital Gaming	CHAS	CLAS
0-7 hours a week	1	1
8-14 hours a week	0	6
15-21 hours a week	-	1
22-28 hours a week	5	3
29-35 hours a week	-	2
36-42 hours a week	3	-
42 hours over a week	1	-

As demonstrated in Table 2, all CLAS play 35 hours or less per week, and some of the CHAS are above this duration. Participant M6H1, who plays more than 35 hours weekly, stated, "I play very often. While playing 8-9 hours weekly, I play more on the weekends. Even I stay awake till morning." Participant F7L16, who spends 9-10 hours a week playing digital games, expressed, “I mean, I play every day. One and a half hours.”

To understand children’s digital gaming habits, the frequency of gaming and the kind of games they prefer were analyzed, and the findings are presented in Table 3.

Table 3. Types of Digital Games Played by Children

Types of Game	CHAS	CLAS
Strategy (MOBA, MMO)	8	3
FPS	3	2
Role-playing game (MMORPG, Sandbox, RPG)	5	3
Adventure	2	2
Intelligence	-	3
Simulation	-	1

As demonstrated in Table 3, the most preferred digital games among children are types of strategy games and FPS. It was determined that CHAS prefers strategy and adventure games more, but not intelligence and

simulation games. Participant F5H4, one of the CHAS who plays strategy and FPS games, stated, "PUBG, and generally gun games. My brother also has games. I play them…"On the contrary, participant F7L5, one of the CLAS who prefers intelligence games, stated, "I like word games. I like learning new words."

Children's Perception of Digital Game Addiction

To reveal children's perception of digital game addiction, their opinions on how they define it, what they liken digital game addiction to, and their opinions related to situations that cause addiction have been analyzed. In this context, the analysis results of their explanations of children's digital game addiction are presented in Table 4.

Table 4. The Explanations of Digital Game Addiction by Children

Digital Game Addiction	CHAS	CLAS
Playing intensively	9	
Being hooked on digital games	7	8
Being preoccupied with digital games	4	3
Making an impression on life	1	1
Postponing something	1	-
Feeling bad without digital games	-	1
Requiring effort to quit digital games	-	1

As demonstrated in Table 4, children mostly explained digital game addiction as "playing intensively." Participant M6H8 expressed, "Digital gaming excessively, gaming until midnight, and even being unable to stop." Some children evaluated digital game addiction as "being hooked on games." The statement of participant F8H5 was that "Children focus on games played by devices like PlayStation, smartphones, and computers, and they never care what's happening around the world." Another statement frequently expressed by CHAS and CLAS was "being preoccupied with digital games." Participant M6L13 stated, "Digital game addiction is to think just about games by depending on them and spend all day on them, not lessons."

The results of the analysis of the metaphors expressed by children for digital game addiction are summarized in Table 5.

Table 5. The Metaphors Related to Digital Game Addiction

Metaphors	CHAS	CLAS
Substance addiction	6	5
Daily habits	2	2
Bad friend	-	2
Need	1	-
Stupidity	1	-
Monster	-	1

As illustrated in Table 5, most of the children liken digital game addiction to substance addiction, such as cigarettes, alcohol, and drugs. Participant M7L15 stated, "It is like smoking addiction. A cigarette addict cannot stand without smoking. Similarly, a game addict cannot stand without gaming." Similarly, participant F8L14 stated, "It is similar to substance addiction because you want to use it over and over when you start to use substances."

Besides substance addiction, children also created different metaphors for digital game addiction. According to Participant F7L18, who emphasizes digital game addiction as a bad friend, "It is like bad friends because it may end badly when you are addicted to them. It causes death like a blue whale". Participant F7H11 likened digital game addiction to stupidity as follows: "If I look at myself from this perspective, I am like a little stupid. I prefer to play games on my smartphone, although there are several places to visit, such as parks, forests, and so forth."

When children's opinions about reasons for digital game addiction were analyzed, some children expressed that games cause addiction due to the characteristics they have. The opinion of participant M7H7, emphasizing the environment provided by digital games to the player, was that "Digital games cause excessive addiction. Because it is his world that he creates, and no one can ask him what to do. He does whatever he wants, and he

does freely.” On the other hand, children explained that factors such as completing missions, winning the game, and passing to the next level cause addiction. Participant M7H12 pointed out, “You have become very ambitious. You have fun as you play. You think you can do better, and so you become addicted." Some children also indicated that the element of entertainment in digital games can cause addiction. Participant F7L19 expressed, “When you start to play a game if you like it, you want to play it continuously. Entertainment is a factor that causes digital game addiction.” Moreover, participant F7L19, who indicates the reason why digital games cause addiction varies by person, expressed that “...I can be addicted because I am exhilarated. Someone also becomes addicted since they play and spend time with friends.”

The Effects of Digital Games

Children’s opinions on the effects of digital games were analyzed. The analysis found that digital games affect children academically, socially, physically, and psychologically. The analysis results related to the effects of digital games on academic performance are presented in Table 6.

Table 6. The Effects of Digital Games on Academic Performance

Academic Effects	CHAS	CLAS
Failure in exam scores	4	3
Improving foreign language	3	3
Distractibility / Dysmnesia	2	4
Neglect of tasks and responsibility	4	2
Acquisition of problem-solving ability	2	1
No Academic effect	1	1

As demonstrated in Table 6, most of the CHAS stated that digital games have a positive effect on improving their foreign language knowledge and skills, while most of the CLAS stated that there are negative effects, such as distractibility or dysmnesia. In this respect, participant F5H4 stated, "I play mathematical games, and they help me in mathematical operations and problem-solving." Participant M5L24 said, "I can benefit from educational games to learn some English words." However, participant F8H5 indicated the negative effects of digital games: "... Before starting to play digital games, I always used to get high scores in exams. My grades have been decreasing more and more since I started digital gaming."

The analysis results related to the effects of digital games on children’s social life are presented in Table 7.

Table 7. The Effects of Digital Games on Children’s Social Life

Social Effects	CHAS	CLAS
Social isolation	5	3
Disruption of family relationships	2	4
Friendship and communication in digital games	3	2
The ease of communicating with foreigners	-	1
Encouraging to play basketball and play the guitar	1	-
None	1	1

As demonstrated in Table 7, two children expressed that digital games do not affect their social lives. On the other hand, participant M6H9, who thinks that there are negative effects on social life, expressed, "I sometimes prefer to play digital games instead of socializing with my friends." According to Participant F6H10, "I can't talk much to my surroundings. And when I speak, I stutter. I don't like that at all. I don’t like it, but I play it anyway." Participant M8H2 expressed how much it affected their social life, "I stayed at home because of digital games; I had no reason to go out." Participant M7L22 explained the disruption of family relationships from the same perspective: “When my parents insist on not playing, I become furious to play. Then, they shut down the computer. So, we cannot get along with each other anymore.”

The results of the analysis related to the effects of digital games on children’s psychology are presented in Table 8.

Table 8. The Effects of Digital Games on Children's Psychology

Psychological Effects	CHAS	CLAS
No psychological effect	4	7
Increasing violence tendency	3	1
Entertaining	1	2
Relaxing	1	-
Being pessimistic/ introverted	1	-
Being obsessed with digital games	-	1
Getting selfish	1	-

As demonstrated in Table 8, approximately half of the children expressed that digital games have no psychological effect. While CHAS mostly expressed the effects of increasing the tendency to violence, CLAS also stated the effects of entertainment. Participant M6H8 said, "I think it causes me to argue with others." On the other hand, participant F7L16 said, "I think digital games are entertaining, so I forget what keeps my mind busy."

Children also pointed out the physical effects of digital games. Children mostly mentioned eye diseases among the physical effects. Participant F7L17 stated her physical problem, "Digital games are harmful to my eyes. Besides, I sometimes have arthralgia". Also, other effects stated by children were that digital games cause skeletal and muscular system disorders and weight gain. Participant F8H5 explained her health condition, "I have pain in my fingers. My eye pain gets more and more. Even I have a headache. While playing games, I have pain in my waist that results from slouching."

The results of the analysis related to the effects of digital games on children physically are presented in Table 9.

Table 9. The Effects of Digital Games on Children Physically

Physically Effects	CHAS	CLAS
Eye diseases	6	3
Body pain (waist, neck, back)	4	1
Weight gain	2	2
Inactiveness	2	1
Finger pain	1	1
Slouching	-	1
None	2	4

As demonstrated in Table 9, children mostly expressed eye diseases regarding the physical effects of digital games. However, children stated that digital games cause weight gain and body pain. Participant F8H5 indicated, "My fingers started to hurt a lot because of playing games. My eye pain has become worse and worse. I have a terrible headache. For example, my back hurts when I stand upright because I slouch too much." Participant F7L17 expressed digital games' negative effects: "It was harmful to my eye health, and sometimes my joints hurt."

DISCUSSION & CONCLUSION

This study aims to conduct an in-depth investigation of digital game addiction and how they are affected by digital games from the perspective of children between the ages of 10-14. Following the study's purpose, children's digital gaming habits, how they perceive digital game addiction, and how digital games affect children are examined.

Children's Habits of Digital Gaming

Digital games are present in children's daily lives, regardless of whether they have a high score of digital game addiction. However, it was revealed that there are differences in the frequency and duration of digital gaming between CHAS and CLAS. It has been observed that the in-game time of non-addicted children does not exceed 35 hours. The fact that the weekly in-game time exceeds 41 hours is considered an indicator of addiction (Wan & Chiou, 2013). In the study conducted with 667 digital gamers between the ages of 11 and 54, digital game addiction was positively related to the time spent on games (Blinka & Mikuska, 2014). In another study conducted with 605 digital game players, players with low psychological endurance played games for over 45 hours (Canale et al.,

2019). Lewis (2016) also indicated that even though digital gaming causes several problems in people's lives, playing games frequently is a signal of addiction. In other many studies, it is mentioned that excess in-game time is positively related to addiction (Derin & Bilge, 2016; Gökçearslan & Günbatar, 2012; Karagöz, 2017; Kurtbeyoğlu, 2018). The fact that children determined to have a high addiction score in this study play more frequently and more games weekly shows similarity to the studies in the literature. On the other hand, some children's in-game time was found to be 7-14 hours a week, even though they were determined to have a high addiction score in this study. This situation can be explained by the limitation of children's in-game time due to several reasons, such as exam periods or time limitations by parents. Indeed, from interviews with parents, Taştekin (2019) states that some parents restrict their children's time spent on digital games. Based on the findings in the present study and studies in the literature, the excess of in-game time is an important factor that leads to an increase in addiction. However, Kneer et al. (2014) noted that uninvolved parents who do not care or neglect their children while they play are risk factors for their children to develop game addiction. In this context, it is clear that families' tendencies on children's in-game time are also important.

It was determined that children's age to start playing digital games changes between the ages of 3 and 12, and the majority of children who started playing games after the age of nine had low addiction scores. The age to start digital gaming decreases day by day. Toran et al. (2016) have indicated that the age to play digital games decreases to 1 -1,5; however, the intensive use of digital games is observed after five years old. Demirtaş Madran and Ferigül Çakılcı (2014) underline that as the age to play digital games decreases, gamers become more addicted and encounter some serious side effects. The study carried out by Karagöz (2017) with 740 children in the 6th and 7th grades shows that digital game addiction increases with age. As stated in the literature, children's age to start digital gaming is an effective factor for their addiction.

In the current study, the most preferred and used digital game devices were smartphones and computers, tablets, game consoles, and television, respectively. In the studies conducted with different age groups in the literature, it is seen that the majority of participants mostly prefer smartphones as a digital game device (Ceylaner & Yanpar Yelken, 2017; Dursun & Eraslan-Çapan, 2018; Kurtbeyoğlu, 2018; Yiğit, 2017). Similarly, this study also showed that the rates of CHAS who have their own smartphone are higher than those of CLAS. The research conducted by Balıkçı (2018) with children between the ages of 10 and 19 shows that %94 of children have smartphones, and they mostly prefer smartphones for digital gaming. Moreover, the study conducted by Bülbül and Tunç (2018) with university students demonstrates that addiction is higher in persons who have smartphones at a young age. The mobility of smartphones and playing online games via smartphones with Internet access make it difficult for gamers to control in-game time. When considering that children do online activities without their parents' permission (Mascheroni & Ólafsson, 2014), the fact that children have a smartphone can trigger addiction because it can be easy to hide online activities from their parents.

In this study, it was found that children preferred strategy games more than others. Strategy games generally are war and economic games. The research conducted by Karagöz (2017) with 740 children between the ages of 11 and 13 indicates that strategy games are positively related to addiction. Bekar (2018) and Kurtbeyoğlu (2018) have emphasized that the rate of not quitting the game for those who play games like war, strategy, and so forth is higher than others. Also, Aleksic (2018) points out that the type of game affects the duration of digital gaming, and time spent on intelligence games is less than on action/sports games. In this study, it was revealed that mind games and puzzles were preferred only by CLAS.

Children's Perception of Digital Game Addiction

The expressions used by children to describe digital game addiction are compatible with the explanation of Lemmens et al. (2009), who state, "even if it causes several problems and playing games excessively and obsessively." In this context, it can be said that children have information about digital game addiction. Besides, children commonly liken digital game addiction to substance addiction. It was found that children express similar metaphors in the study by Hazar et al. (2017) conducted with 364 children between the ages of 10 and 14. The fact that children liken digital game addiction to substance addiction, which is difficult to treat and quit, shows that they are aware of the dimensions of this risk.

Half of the participants expressed that the immersive nature of digital games causes addiction. The variation in digital games, the attractiveness of graphics and images (Nazlıgül et al., 2018), and factors such as arousing interest and character design affect addiction (MHGDHP, 2018). It can be considered that these features make digital games fascinating and cause addiction. Indeed, Lemmens et al. (2009) defined mood modification, which is one of the criteria of digital game addiction, as gamers being inclined to the game to get rid of distress because

they experience the entertainment of digital games and experience this feeling over other feelings. In this study, children explained that digital games cause addiction because they are pleasurable and entertaining. Wood (2008) indicates that when digital game players cannot find anything to do, they tend to play digital games and fulfill their entertainment needs. Besides, most participants who said they played digital games to complete a task or win were CHAS. Also, gradual transition scores and competition in digital games become attractive and pave the way for addiction (MHGDHP, 2018). Another factor in the fact that addicted children continue to play the game is that they do not want to give up the character they have created (Wood, 2008). Furthermore, some of the addicted children consider digital games as a world where they can be isolated from real life and make decisions autonomously (King et al., 2013). Although children often liken digital game addiction to substance addiction, the fact that they have many reasons to play makes it more difficult to prevent and cope with its risk.

The Effects of Digital Games on Children

The children expressed positive and negative opinions while evaluating the effects of digital games. Expressing positive opinions, children mentioned that digital games mostly contribute to foreign language learning. Digital games in foreign language education facilitate vocabulary learning (Ceylaner & Yanpar Yelken, 2017). Some children stated that digital games improve their foreign language because most digital games are based on a foreign language, and the dialogues, names of tools, menus, and instructions in digital games are in a foreign language, and even they sometimes need to communicate with foreign players. In addition, children stated that digital games improve their problem-solving skills. Developing problem-solving skills, increasing imagination, and improving visual intelligence are among the benefits of digital games (Smith, 2004; Yalçın & Bertiz, 2019). Some children also indicated that digital games negatively affect their academic success. The fact that as well as CHAS, CLAS also stated that the decrease in their academic success could be interpreted as their being in the risk group. Karacaoğlu (2019) underlines that academic success decreases while addiction increases, and Kuss and Griffiths (2012) indicate that gamers who play digital games excessively have difficulty fulfilling their responsibilities in daily life. Similarly, children said they ignore their tasks, such as doing homework, going to school, and solving problems, because they play digital games. In this context, it can be said that there is a thin line between the benefits and harms of digital games in terms of children's academic success.

While evaluating the social effects of digital games, children explained that they have problems with their family relationships and are isolated from the social environment. In the literature, children have similar problems due to digital games (Kim et al., 2008; Köse, 2013); it is seen that many addicted players are phobic about socialization, and this phobia increases digital gaming behavior (Kneer et al., 2014). Children's need to spend more time socializing with their friends than their families is normal for this age period (Doğan, 2007). However, it is seen as worrying that children communicate with people they do not know while playing digital games and their efforts to socialize in virtual worlds (Bilgin, 2015). Similarly, Dönmez (2018) underlines that most children make new friends in digital games, and some even meet these virtual friends in the real environment. It was concluded that their preference to socialize with people they meet in digital games rather than the people around them, like their family or friends, negatively affects their social development.

Children often mentioned the physical effect of digital games in their interviews. They stated that digital games cause visual impairment, eye burning, eye irritation, eye pain, and xerophthalmia. Visual impairment is a problem experienced by many people who play digital games regardless of whether they are addicted or not (Kuss & Griffiths, 2012; Mustafaoğlu & Yasacı, 2018). It is usual that children express easily noticeable situations such as eye diseases and musculoskeletal problems, which manifest themselves as pain and physical appearance. It was seen that another physical effect explained by children is to gain weight. Digital games cause weight gain and even obesity due to remaining still for a long time and irregular eating habits. (Berber et al., 2014; MHGDHP, 2018). Aksoy (2018) determines a statistically meaningful relationship between digital game addiction and obesity. The findings related to the relationship between digital game addiction and weight gain are available both in the current study and in other studies in the literature. Children stated that they also have pain in their hands, wrists, and joints because of digital gaming. Griffiths and Meredith indicate that Carpal Tunnel Syndrome, headache, and backache can occur depending upon the excessive use of digital devices (as cited in., Hazar et al., 2017). Children need to do sports activities when their physical growth and development are most intense in both their physical and social, cognitive, and psychological development (Coknaz, 2016; Koç, 2004). However, it is seen that digital game addiction prevents children from living this period healthfully.

Although some children stated that digital games are fun and relaxing, children often mentioned the negative effects. Particularly, CHAS expressed that digital games increase their tendency to violence. Çakıcı

(2018) presents that addicted children express their anger more than non-addicted children. In the literature, there is also evidence showing that the tendency to violence increases as game addiction increases (Aydoğdu Karaaslan, 2015; Balıkçı, 2018; Baş, 2018; Güvendi et al., 2019). The explanations of CHAS about the increase in the tendency to violence caused by digital games indicate that they are aware of the psychological effects they have. The psychological effects expressed by children that include refrainment, fatigue, being introverted, pessimistic, and depressed can be associated with anxiety. Karaca et al. (2015) point out that there is a positive relationship between game addiction and anxiety and adds that both can be a cause or a result of each other. In the literature, there are studies in which digital game addiction is associated with depression and anxiety disorder (Baş, 2018) and with depressive mood, loneliness, social anxiety, and negative self-perception (Rooji, 2010). Even Canale et al. (2019) noted that digital games can be used to cope with stress. Accordingly, it can be said that digital game addiction may be the cause or result of psychological problems.

Recommendations

Based on the results obtained from the study, digital game addiction is tried to reveal from the eyes of children between the ages of 10-14. The research findings are limited to 24 children between the ages of 10-14 who participated in the study and with the year the data were collected. In addition, the determination of children's digital game addiction status in the study was not based on clinical information but was determined by using the Hazar and Hazar (2017) scale. Accordingly, the following recommendations can be listed given the findings obtained from the study:

- Parents can manage their children's in-game time to assess their digital game addiction status.
- Training can be organized to increase parents' awareness that children's introduction to digital games at an early age causes addiction, and that guides them to take precautions in this regard.
- It may be beneficial for parents to install a parental control application on their children's mobile devices to control their children's digital in-game time and guide their activities in the digital world.
- When children want to play digital games, it may be helpful for parents to direct their children to games such as intelligence and puzzles.
- Studies can be conducted that examine the reasons behind children's continuance of gaming behavior despite being aware of the risk of addiction to digital games.

Children's interest in digital games should be directed towards educational games that positively affect their cognitive and academic development. The relevant stakeholders, especially parents, teachers, and researchers, can conduct common studies to determine and disseminate these games.

- To reduce the time children spend on digital games and prevent them from becoming game addicts, they can be encouraged to participate in in-school or out-of-school activities that support their growth and development, such as sports, folklore, music, painting, and handicrafts.
- By considering that digital game addiction may be the cause or result of psychological problems, children can be followed up by experts periodically through performing game addiction and psychological screening tests.

Statements of Publication Ethics

We declare that the study has no unethical problems, and ethics committee approval was obtained from Atatürk University Social and Human Sciences Ethics Committee (Date: 14/02/2019 Decision No: 03/01).

Researchers' Contribution Rate

Researchers' Contribution Rate (You may modify this table according to your article)

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Discussion & Conclusion
Author 1's name	☒	☒	☒	☒	☒	☒
Author2's name	☒	☒	☒	☒	☒	☒
Author 3's name	☐	☐	☒	☒	☒	☐
Author 4's name	☒	☒	☒	☒	☒	☒

Conflict of Interest

This study has no conflict of interest.

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APPENDIX

Appendix1: Demographic Characteristics of the Participants

Code	Grade	Gender	Age	Addiction Status	Addiction Scores
M6H1	6	Male	12	CHAS	112
M8H2	8	Male	13	CHAS	79
M6H3	6	Male	12	CHAS	86
F5H4	5	Female	12	CHAS	98
F8H5	8	Female	14	CHAS	89
M8H6	8	Male	13	CHAS	112
M7H7	7	Male	13	CHAS	80
M6H8	6	Male	12	CHAS	81
M6H9	6	Male	12	CHAS	79
F6H10	6	Female	12	CHAS	77
F7H11	7	Female	13	CHAS	77
M7H12	7	Male	13	CHAS	78
M6L13	6	Male	12	CLAS	67
F8L14	8	Female	14	CLAS	35
M7L15	7	Male	12	CLAS	65
F7L16	7	Female	13	CLAS	46
F7L17	7	Female	13	CLAS	39
F7L18	7	Female	13	CLAS	26
F7L19	7	Female	13	CLAS	45
M7L20	7	Male	13	CLAS	57
M6L21	6	Male	12	CLAS	36
M7L22	7	Male	13	CLAS	51
M5L23	5	Male	10	CLAS	67
M5L24	5	Male	11	CLAS	50

Appendix2: Interview Form

1. How old are you? Do your parents work? What is their educational status?

2. What do you do in your spare time?

3. What do you think about the game? The game is like ……, because …….

4.What comes to your mind when you think of digital games? (Digital games are mobile games, video games, online games, and computer games where data is entered with tools such as a keyboard or joystick and is displayed through the screen)

5. Do you play digital games?

-How long have you been playing games?

-Who did you meet with digital games?

-Which devices do you use to play games? (Computer, desktop, tablet, smartphone, game console)

-Does the device you play with belong to you or do you have it in your room?

-How often and how long do you play? (Every day (once a day, more than once), every few days, one day a week, on weekends, one per month)

6. What kind of digital games do you play? Which game do you play the most?

7. How do you feel while playing digital games?

8. How do you want to feel while playing digital games? What do you aim for?

9. What is the place and importance of digital games in your life? (Above what, after what?)

10. What benefits did digital games have for you? Can you explain?

11. Do you think digital games harm you? Can you explain? (Is there anyone around you that you think s/he has been harmed by digital games? What kind of damage do you think they have?)

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Improving Pre-Service Social Studies Teachers' Scientific Research Self-Efficacy (SRSE)

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Abstract

In this research, it was aimed to improve the SRSE of pre-service social studies teachers through the educational process designed by the researchers. The study, conducted with a mixed embedded design, spanned four weeks. During the first week, a problem-based learning approach was implemented, followed by 5E and 7E learning activities and mastery learning in subsequent weeks. The participant group of the research consisted of 46 students studying in the second year of the social studies teaching department of a university in Turkey. Data were gathered personal information form, SRSE Scale and semi-structured interview form. T-test for dependent samples and Wilcoxon signed-rank test were used to analyze the data. Findings revealed that the education process applied in the research developed the SRSE of the pre-service social studies teachers both in general and within the scope of the literature, method, result and discussion, suggestion development and reference writing dimensions. Qualitative findings were found to support the quantitative findings. Various suggestions were developed depending on the research findings.

Keywords: Social studies, pre-service teachers, scientific research, scientific research self-efficacy.

Sosyal Bilgiler Öğretmen Adaylarının Bilimsel Araştırma Öz Yeterliklerinin Geliştirilmesi

Öz

Bu araştırmada araştırmacılar tarafından tasarlanan bilimsel araştırma öz yeterliliği kazandırmaya yönelik eğitim süreci aracılığıyla sosyal bilgiler öğretmen adaylarının bilimsel araştırma öz yeterliklerinin geliştirilmesi amaçlanmıştır. Karma gömülü desen ile yürütülen araştırmanın uygulama süreci, dört hafta sürmüştür. Uygulama sürecinin ilk haftasında probleme dayalı öğrenme; ikinci haftasında 5E öğrenme; üçüncü haftasında 7E öğrenme ve dördüncü haftasında tam öğrenme yaklaşımına dayalı geliştirilen etkinlikler uygulanmıştır. Araştırmanın katılımcı grubu, Türkiye'deki bir üniversitenin sosyal bilgiler öğretmenliği bölümünün ikinci sınıflarında öğrenim görmekte olan 46 öğrenci oluşturmaktadır. Araştırmanın verileri; kişisel bilgi formu, Bilimsel Araştırma Öz-Yeterlilik Ölçeği ve yarı yapılandırılmış görüşme formu aracılığıyla toplanmıştır. Araştırmanın verileri çözümlenirken bağımlı örneklemler için t-testi ve Wilcoxon işaretli sıralar testinden yararlanılmıştır. Araştırmada uygulanan eğitim sürecinin sosyal bilgiler öğretmen adaylarının bilimsel araştırma öz yeterliliklerini hem genel olarak hem de alanyazın, yöntem, sonuç ve tartışma ve öneri geliştirme ve referans yazma boyutları kapsamında geliştirdiği belirlenmiştir. Araştırmada ayrıca sosyal bilgiler öğretmen adaylarının bilimsel araştırma öz yeterliği kazandırmaya yönelik eğitimin kendilerine hem genel bilimsel araştırma öz yeterliği hem de alanyazın, yöntem, sonuç ve tartışma ve öneri geliştirme ve referans yazma boyutları temelinde yeterlik kazandırdığı görüşüne sahip oldukları saptanmıştır. Araştırmada ulaşılan sonuçlara bağlı olarak çeşitli önerilerde bulunulmuştur.

Anahtar kelimeler: Sosyal bilgiler, öğretmen adayları, bilimsel araştırma, bilimsel araştırma öz yeterlikleri

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INTRODUCTION

Social studies is a course that aims to equip primary and secondary school students with the knowledge, skills and values they need in daily life (Deveci & Bayram, 2022). In other words, the social studies course aims to provide students with proficiency in daily life. Gaining the competencies that students need in the social studies course is only possible if the teachers who give social studies education to the students are equipped in the aforementioned scope (Evans, 2004). One of the competencies that students need in daily life and that the social studies course aims to develop is scientific research self-efficacy (Russel III & Waters).

SRSE refers to knowing the stages of a scientific research and becoming competent on how to conduct it (Towne & Shavelson, 2002). The stages of scientific research are listed as follows (Cross, Naughton, & Walker, 1981; Gauch & Gauch, 2003):

- Gathering information through observations
- Collecting data from observations and experiments
- Formulating tentative hypotheses
- Making predictions based on hypotheses
- Conducting controlled experiments
- Analyzing data from experiments
- Reporting findings
- Developing general theories and laws explaining the problem

Enhancing students' SRSE in social studies courses is contingent upon the competence of their social studies teachers in this area. Thus, it is imperative that social studies teachers receive training during their educational preparation that equips them with the necessary competencies. Specifically, social studies teachers must be trained not only in how to teach life-relevant variables to primary and secondary school students but also in the methodologies of conducting scientific research (Bayram, 2021). Pre-service social studies teachers, who will become the social studies educators of the future, bear the primary responsibility for designing educational processes aligned with the goals of social studies. Consequently, it is essential to research and enhance the scientific research competencies of these pre-service teachers. This research aims to elevate the SRSE levels of pre-service social studies teachers, particularly addressing the low levels of SRSE observed among these teachers at the university where the study was conducted. The researchers, who are academicians at this university, initiated the study to address this issue.

The literature is replete with studies on the development of scientific research self-efficacy among prospective mathematics and science teachers (Albareda-Tiana et al., 2018; Anisimova et al., 2020; Presnukhina et al., 2020) as well as mathematics teachers (Koichu & Pinto, 2018; Wareerat et al., 2016). Additionally, there are studies focused on assessing the SRSE of pre-service teachers, practicing teachers, and students (Büyüköztürk, 1999; Cortes, 2019; İlhan et al., 2016; Laidlaw et al., 2012; Derling et al., 2018). However, there is a noticeable gap in the literature regarding studies aimed at improving the SRSE of pre-service social studies teachers. Enhancing the SRSE of these pre-service teachers is crucial for achieving the objectives of social studies education, as today's pre-service teachers are tomorrow's social studies educators. The absence of research on this topic is recognized as a deficiency and motivated this study. It is anticipated that this research will contribute original findings to the scientific literature and serve as a resource for similar future studies. Additionally, it is expected to highlight the importance of developing scientific research self-efficacy among pre-service social studies teachers.

Research Questions

This research aimed to enhance the Scientific Research Self-Efficacy (SRSE) of pre-service social studies teachers through a training program specifically designed by the researchers. To achieve this objective, a hypothesis was tested, and a research question was posed. The hypothesis and the corresponding research question are as follows:

- **Hypothesis:** Education designed to enhance SRSE effectively improves the scientific research self-efficacy of pre-service social studies teachers.
- **Research Question:** What are the perspectives of pre-service social studies teachers regarding the impact of education on their scientific research self-efficacy?

METHOD

Research Design

The research employed a mixed research methodology, utilizing a mixed embedded design. This design aims to complement quantitative data with qualitative data collected at one or more stages of the research process (Creswell & Plano Clark, 2020). The rationale for using the mixed embedded design is that the study was conducted in an experimental framework.

Participants

The participants comprised second-year pre-service teachers enrolled in the social studies teaching department at a state university in Turkey. The selection of second-year pre-service teachers was intentional, as the scientific research methods course is offered in the second year of the social studies teaching program. Two distinct groups of participants were involved: the first group consisted of 46 students from whom quantitative data were collected, and the second group included 8 students from whom qualitative data were gathered. All participants were pre-service teachers studying at the same university where the researchers are employed.

The convenience sampling method was employed to select the quantitative group. This method involves selecting the most readily available subjects due to time and other constraints (Büyüköztürk, 2020). Details about the quantitative group are presented in Table 1. As seen Table 1, there were more females (54.35%) and males (45.6%).

Table 1. Demographic Characteristics of the Quantitative Group

Variable	Category	*f*	*%*
Gender	Female	25	54.35
	Male	21	45.65
	Total	46	100

In the second phase, the qualitative group was established, consisting of volunteer pre-service teachers who agreed to participate in interviews. This group included 8 volunteers: 3 males and 5 females. To maintain confidentiality in accordance with ethical principles, the participants' names were anonymized and coded as S1, S2, S3, etc., in the research.

Data Collection

Data were collected using a personal information form, the "Scientific Research Self-Efficacy Scale" developed by Tuncer and Özeren (2012), and a semi-structured interview form created by the researchers. The scale comprises 12 items across four dimensions: (1) literature review, (2) methodology, (3) conclusions and discussions, and (4) suggestion development and reference writing. It is structured as a five-point Likert scale. Tuncer and Özeren (2012) reported a Cronbach's Alpha coefficient of .846 for this scale. To confirm its applicability for this research, the scale's reliability was reassessed with a group of 187 pre-service teachers. The Cronbach's Alpha values for both the overall scale and its sub-dimensions are presented in Table 2. As illustrated in Table 2, the Cronbach's Alpha values exceed .70 for both the overall scale and its sub-dimensions, indicating that the scale is sufficiently reliable for use in this research (Tabachnick & Fidell, 2001).

Table 2. Reliability Test results for Scientific Research Self-Efficacy Scale

Sub-scale	Cronbach's Alpha
Total	.848
Literature	.738
Method	.777
Conclusion and Discussion	.884
Suggestion Development and Reference Writing	.873

Data Analysis

To determine the appropriate statistical techniques for analyzing the research data, the normality of the differences between the pre-test and post-test data was assessed. This involved examining the skewness and kurtosis of the pre-test and post-test differences, as well as the results of the Kolmogorov-Smirnov (K-S) test. The K-S test was utilized to investigate the normality distribution due to the sample size exceeding 30 participants (McKillup, 2012). The results are presented in Table 3.

Table 3. Skewness and Kurtosis Values of the Pre-test Data

Variable	***Skewness***		***Kurtosis***		***Kolmogorov-Smirnov***
	Skewness	*SD*	*Kurtosis*	*SE*	
Total	.163	.350	-.395	.688	.000
Literature	-.165		.027		.004
Method	.485		-.558		.002
Conclusion and Discussion	.822		.623		.124
Suggestion Development and Reference Writing	-.194		-.523		.055

As shown in Table 3, the skewness and kurtosis values for the overall scale and all sub-dimensions fall within the range of -1.5 to 1.5 (Tabachnick & Fidell, 2019). Upon examining the K-S test results in the table, it is evident that the values for the literature and method sub-dimensions, as well as the overall scale, are less than .05, indicating a non-normal distribution. Conversely, the values for the conclusion and discussion, and suggestion development and reference writing sub-dimensions are greater than .05, indicating a normal distribution. Based on these findings, the Wilcoxon signed-rank test, a non-parametric test, was used to analyze data from the overall scale and the literature and method sub-dimensions. The dependent sample t-test, a parametric test, was employed to analyze data from the conclusion and discussion, and suggestion development and reference writing sub-dimensions. Additionally, the research fit matrix developed by Kaya and Bayram (2021) was utilized to assess the fit between the research variables.

Research Process

Prior to the commencement of the implementation phase of the study, pre-service social studies teachers underwent a pre-test using a specific scale to assess their levels of SRSE. Subsequently, the training program aimed at enhancing scientific research self-efficacy was initiated. Following the completion of the training, a post-test was administered to re-evaluate their SRSE levels. In the subsequent phase, interviews were conducted with the pre-service teachers. The qualitative data obtained from these interviews, along with the quantitative data, were thoroughly analyzed. The research process is illustrated in Figure 1.

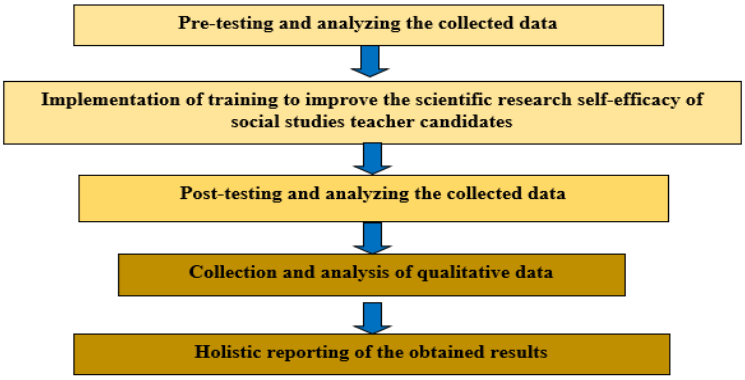

Figure 1. *Research Process*

The educational intervention aimed at enhancing self-efficacy in scientific research incorporated a hybrid learning framework, grounded in four distinct pedagogical models or approaches. Each week of the four-week training program employed a different learning approach. This variation was intentional, as the focus of the research was on the overall impact of the hybrid educational process rather than the singular effects of individual learning models. The learning approaches utilized throughout the training are detailed below:

In the first week, the objective was to equip pre-service social studies teachers with skills in literature review, summarization, and clear articulation of research goals. To achieve this, a Problem-Based Learning (PBL) approach was employed. Prior to the lessons, lesson plans and activities tailored to PBL were developed and implemented. During the lessons, participants were organized into groups and presented with problems related to literature review. They were then tasked with devising solutions in line with PBL principles, which emphasize experiential learning through the investigation and resolution of complex, real-world issues and necessitate active engagement of participants (Deveci, 2002; Allen, Donham, & Bernhardt, 2011).

The second week focused on enhancing participants' competence in methodological aspects such as writing sub-objectives, data collection, data analysis, and participant selection. The 5E Learning Approach was applied during this phase. Lesson plans and activities were crafted according to the 5E framework, which includes the stages of "engage, explore, explain, elaborate, and evaluate" (Bybee et al., 2006; Gürel, 2021). The training adhered to these stages to facilitate the development of methodological skills.

In the third week, the goal was to improve participants' ability to interpret and organize research results comprehensively and to discuss these results in relation to existing literature. The 7E Learning Approach was utilized for this purpose. Prior to the lessons, lesson plans and activities based on the 7E model were designed and implemented. This approach involves a sequential process starting with assessing prior knowledge and culminating in the application of learned information to real-life contexts. The stages of the 7E model are elicit, engage, explore, explain, elaborate, evaluate, and extend (Bayram, 2022; Eisenkraft, 2003).

The final week aimed to enhance the participants' ability to formulate research-based proposals and to write references in compliance with international standards. The Mastery Learning Approach was employed during this phase. Lesson plans and activities reflecting the principles of mastery learning were prepared and executed. This approach operates on the premise that with appropriate conditions and environment, all students can learn effectively. It emphasizes the identification of student levels, learning speeds, and affective characteristics to design suitable educational and assessment strategies (Senemoğlu, 2010).

Research Ethics

This study was conducted with approval from the ethics committee, in accordance with the decision of the Ağrı İbrahim Çeçen University Scientific Research Ethics Committee, dated November 8, 2022, and numbered 239. Subsequently, the researchers provided participants with detailed information about the study, and consent was obtained through the signing of a consent form. Participants' identities were kept confidential.

FINDINGS

The results of the study are categorized into two principal sections: quantitative findings and qualitative findings. The details pertaining to each of these categories are presented below.

Quantitative Findings

In the study, SRSE levels of pre-service social studies teachers were initially assessed. Subsequently, pre-test data were gathered and analyzed. Following the training intervention, post-test data were collected. The Wilcoxon signed-rank test was employed to analyze the data from the overall scale, as well as from its literature and method sub-dimensions. The results are presented in Tables 4, 5, and 6.

Table 4. Wilcoxon Signed Ranks Test General Results

Posttest-Pretest	*n*	*So*	*St*	*Z*	*p*	*r*
Negative order	0	.00	.00	-5.909	.00	.87
Pozitive order	46	23.50	1081.00			
Equal	0					

As indicated in Table 4, there was a significant increase in the proficiency levels of pre-service social studies teachers on the total scale ($p<.05$; positive=46), suggesting that the training aimed at enhancing SRSE was effective in improving the SRSE of the pre-service teachers. The data presented in Table 4 further demonstrate that the effect size of the training was substantial, as evidenced by the large impact on the total scale ($r>.50$). Additionally, the results led to the rejection of the null hypothesis (H_0) and the confirmation of the alternative hypothesis (H_1).

Table 5. Wilcoxon Signed Rank Test Literature Results

Posttest-Pretest	*n*	*So*	*St*	*Z*	*p*	*r*
Negative order	0	.00	.00	-5.737	.00	.84
Pozitive order	21.50	903.00	.00			
Equal	4					

An examination of Table 5 reveals that the proficiency levels of pre-service social studies teachers in the literature sub-dimension have significantly increased (p<.05). Specifically, proficiency improved for 42 participants, while 4 participants showed no change (positive=42; equal=4). The effect size was determined to be large (r>.50), indicating that the training substantially enhanced the participants' competencies in this area.

Table 6. Wilcoxon Signed Rank Test Method Results

Posttest-Pretest	*n*	*So*	*St*	*Z*	*p*	*r*
Negative order	0	.00	.00	-5.917	.00	.87
Pozitive order	46	23.50	1081.00			
Equal	0					

Similarly, Table 6 demonstrates a significant increase in proficiency levels for pre-service social studies teachers in the method sub-dimension (p<.05; positive=46). The effect size was also large (r>.50), suggesting that the training effectively improved the participants' skills in this dimension as well.

The data for the results and discussion, suggestion development, and reference writing sub-dimensions were analyzed using a dependent samples t-test. The results, presented in Table 7, show that the p-values for these sub-dimensions were below .05. This indicates a significant improvement in the proficiency levels of pre-service social studies teachers, with a substantial impact (η2>14).

Table 7. Dependent Samples T Test

Variable	Test type	*n*	*x*	*ss*	*t*	*p*	*η2*
Conclusion and Discussion	Post-test	46	4.4638	.49927	8.419	.000	.61
	Pre-test		3.2029	.89022			
Suggestion Development and Reference Writing	Post-test		4.4348	.52291	10.928	.000	.72
	Pre-test		2.9348	.80006			

Qualitative Findings

To complement the quantitative findings, semi-structured interviews were conducted with volunteers from the sample group at the conclusion of the study. The data collected from these interviews, which sought to gather pre-service teachers' opinions on the impact of the training, were analyzed using descriptive analysis. The results are detailed in the following sections.

Development of Scientific Research Self-Efficacy

It was found that all of the participants were of the opinion that the training aimed at gaining SRSE applied in the research improves their scientific research self-efficacy. The most striking of the views that form the basis of this finding are presented below. S3 expressed that,

> *"I have learned a lot about scientific research from the beginning of the term until now. In other words, to be frank, I learned what scientific research means during this period. How is work done? He expressed that the education applied with the expression "What should one pay attention to while working."*

A similar opinion was presented by S6:

> *"We are now in the second grade. We have taken a scientific research course before, but it has not fully settled in our minds. So it wasn't in my head. In this course (Experimental process in which the training process is applied), we made various applications. Everything got better in our heads. You (the*

researcher who conducted the interview) had us do studies to set an example in the classroom. It is evident from the work we have done, that we have made quite a bit of progress. That's for sure. Now I can say that we know something."

Another participant who had the opinion that it improved SRSE was S2 who said, *"I think I have learned scientific research now. If you tell me now, go do some scientific research, I think I can do it now."* He stated that he had the opinion that the experimental procedure made gains for him. Similar to S2's statements, S8 said, *"I think I can do scientific research on my own now. This period has given me a lot in terms of scientific research."*

It was seen that the qualitative findings arrived at in the research supported the quantitative findings. Accordingly, it can be stated that the education aimed at improving SRSE improved the SRSE of pre-service social studies teachers.

Competence in Literature Review

It was determined that the participants in the research developed a perspective that the training aimed at improving SRSE makes them competent in the review of the literature. S7, one of the participants with this point of view, used the following statements:

"Now I knew beforehand what literature was. I knew, but I thought scanning the literature was just a Google search. But now I learned that there are a lot of other databases. I also learned that the literature review cannot be done only on the internet. One must sit down and read books and articles. It is not just a job to search the literature on the internet. Because why do I say so? When we do research from solid books (the most accepted sources in the scientific literature), we reach the most solid information. This is crucial for robust literature research."

As can be understood from the statements of S7, S7 has the opinion that he has become competent on how to examine the literature during the applied training process. Another participant, S4, stated that *"Literature scanning is not just collecting information from the internet. It is fed from many different sources. My other friends and I used to think so too (before the experimental procedure). Now I realize it means doing decent research."* Two very similar opinions came from S1, S3 and S8, in line with the fact that the training process enabled pre-service teachers to become competent in the review of the literature. The mentioned participants used clear and short statements on the subject. The statements of the participants are as follows:

S1: *"It is necessary to reach scientific sources in the literature review."*

S3: *"When scanning the literature, it is absolutely necessary to conduct comprehensive research."*

S8: *"The review of the literature is the primary step of scientific research. If we're going to do something that everyone can accept. We need to know how to examine the literature well."*

The alignment between the qualitative and quantitative findings suggests that the training significantly enhanced pre-service social studies teachers' abilities in literature review.

Competence in the Method

Intense content related to scientific research methods was used in the research. In the lessons, activities related to quantitative, qualitative and mixed research methods were carried out and it was tried to ensure that pre-service teachers learn about these methods. At the end of the research, it was determined that majority of the participants believed they were competent in the method. Some of the opinions in this context are given below:

"I realized that the scientific method is a very broad subject. It branches out within itself. I think I've learned a little more in this month. It used to be qualitative and quantitative karma... I never knew about these. But now maybe I'm able to do some research myself." (S5)

In line with the expressions used by S5; It can be said that S5 both learned descriptive information about the method and had the view that he made progress in method design during the implementation process. Another participant S8, who has the view that the experimental process makes the pre-service social studies teachers competent about the method, expressed that:

"We did a research project a couple of weeks ago. We did group work on the project. We saw that the method was very important in that project. Because method means programming the research from start to finish. That's why the method is so important. If the method is not known, research cannot be done. There is no research in life. That's why we focused on the method. Now I think we know the method."

When the above statements are examined, it is understood that S8 sees the experimental process of the research as a process that enables the method to be learned both theoretically and practically. A close view was presented by participant S2 who expressed that *"It is necessary to learn the method. We learned quite a bit about the method during this period. The backbone of a research is method part."* He stated that he understood the importance of the method in the implementation process. Continuing his words, S2 said that *"I can say that I learned a little about the method on my own behalf. Okay, maybe I don't know as much as an academic, but I still learned a lot."* He expressed his opinion that the experimental process made him competent in the method.

These qualitative insights support the quantitative findings, indicating that the training improved pre-service social studies teachers' methodological competencies.

Competence in Conclusion and Discussion

Participants acknowledged that the training improved their abilities in the conclusion and discussion phases of scientific research. Notable comments include:

S3: *"Writing conclusions and discussing the results shows what the contribution of scientific research to science is. In my exemplary project with my own group, I see myself as proving that I have progressed in writing and discussing results."*

S6: *"The more important the aims of a research are, the more important it is to express the results well. We totally understand this. I don't think I'm the only one who understands this. I think my other friends understand that too. Because in the work we have done with groups, I have seen that everyone learns this trade."*

S8: *"If scientific results are discussed, they can be important. If I do scientific research, one day, I will definitely take this into consideration. We have seen with our own eyes how important it is (result and discussion) in our case studies so far. This is important."*

Direct quotations from the statements of these participants indicate that they have realized the importance of the conclusion and discussion sections in scientific research. It is understood that the participants also think that they have become competent about the conclusion and discussion sections.

These statements reveal an increased awareness of the significance of conclusion and discussion in scientific research. The qualitative findings corroborate the quantitative results, indicating that the training effectively enhanced pre-service social studies teachers' competencies in this phase.

Competence in Proposal Development and Reference Writing

In the research, it was found that the participants believed they were competent in developing suggestions and writing references as a result of the implementation process. The most important views on which these findings are based are presented below with direct quotations.

S2 expressed his opinion on the subject in a comprehensive way stating that

> *"For example, we are doing research. After doing the work, we reach the results. We also need to make recommendations from the results. Otherwise, no one will see the benefit of our work. Making suggestions should also be in the form of "can, can be done" as you (the researcher who conducted the interview) taught us."*

Another participant, S5, said that *"We need to indicate in our research in a way that it can be understood which authors the information we use in the research belongs to. Scientific ethics and scientific morality require this."* He showed that he was aware of the importance of writing a reference by voicing his words. Another participant stated that *"The bibliography is important. We need to rank our sources in alphabetical order and in chronological order. We should also make it suitable for formats such as APA or MLA. We use APA because we are educators"* (S7). S7's mention of some of the approaches used in specifying references reveals that he has learned about writing references.

It has been determined that the qualitative findings on proposal development and reference writing support the statistical findings. In this context, it can be said that the education aimed at improving SRSE makes pre-service social studies teachers competent in developing suggestions and writing references dimension.

DISCUSSION & CONCLUSION

This study aimed to enhance SRSE of pre-service social studies teachers through a structured training program. The results of this research are discussed in relation to similar studies found in the literature.

As previously mentioned, an eclectic or hybrid educational model was employed in this research. During the initial week of the training, the goal was to equip pre-service social studies teachers with skills in literature review, summarizing information, and clearly articulating research objectives. The Problem-Based Learning (PBL) approach was utilized for this purpose. Both quantitative and qualitative findings indicate that this training effectively improved the participants' competencies in literature review. These results align with studies that demonstrate the PBL approach enhances students' scientific process skills (Öztürk, 2019; Söyleyici, 2018), though they contrast with studies suggesting that PBL does not significantly impact these skills (Serin, 2009; Yıldız, 2010). The discrepancy may be attributed to differences in the training implementation or the characteristics of the participants. Additionally, variations in age and subject areas of the students may contribute to these differing outcomes.

In the second week, the focus shifted to enhancing participants' knowledge in methodological aspects, including writing sub-objectives, data collection, data analysis, and participant selection. The 5E learning model was applied during this phase. The qualitative findings regarding methodology corroborate the quantitative data, suggesting that the training improved the participants' methodological competencies. These results are consistent with studies indicating that the 5E learning model enhances academic achievement (Güleç, 2020; Kıcır, 2014; Aydoğdu, 2022; Ekmekçi, 2022; Demir & Şahin, 2015; Başer, 2008; Fazelian & Soraghi, 2010; Sakallı, 2011; Dağ, 2015; Omotayo & Adeleke, 2017; Aygün, 2019; Ağgül Yalçın & Bayrakçeken, 2010; Grau et al., 2021; Tüysüz & Geban, 2020; Zia & Choudhary, 2020), primarily in mathematics and science fields. This indicates that the 5E model is also effective in social studies education and enhances SRSE.

The third model applied was the 7E learning model, an advanced version of the 5E model. The findings reveal that the 7E model improved the scientific process skills of pre-service social studies teachers, consistent with the results of Kanlı (2007) and Kanlı & Yağbasan (2008). Additionally, although an academic achievement test was not utilized, the model appeared to increase participants' academic performance, as evidenced by the improvement observed in the end-of-semester evaluation exams. This finding supports previous studies that assert the 7E model's effectiveness in enhancing academic achievement (Avcıoğlu, 2008; Çelik & Özbek, 2013; Çepni et al., 2001; Demirezen, 2010; Eisenkraft, 2003; Gönen & Kocakaya, 2010; Gürbüz, 2012; Köksal, 2014; Özbek et al., 2012; Sornsakda et al., 2009; Turgut et al., 2013; Zıngal, 2015).

The final model employed was the mastery learning model, which operates on the principle that effective learning occurs when appropriate conditions and environments are provided. This model differs from traditional education by centering the student in the learning process. Two exams were administered during the semester: one mid-term and one at the end. The end-of-semester evaluation revealed an increase in academic achievement, indicating that the mastery learning model facilitated learning and improved academic performance. These results are consistent with research showing that mastery learning is more effective than traditional teaching methods (Bucak, 2020; Erdemci, 2015; Ersoy, 2014; İşeri, 2004; Karaca, 2007; Öner, 2005).

In conclusion, the training program applied a different learning model each week over a four-week period. The chosen models were based on constructivist principles, which emphasize student-centered and active learning approaches. By using varied models weekly, the program aimed to avoid monotony in the teaching and learning process. The findings suggest that this diverse, student-centered approach effectively improved the SRSE of pre-service social studies teachers. Therefore, adopting an eclectic approach, rather than relying on a single instructional model, may be more beneficial for enhancing SRSE.

Based on the research findings, the following recommendations are proposed:

- Incorporate additional courses focused on SRSE development into social studies education undergraduate programs.
- Develop educational applications designed to enhance SRSE within the social studies education curriculum.
- Mandate scientific research projects for pre-service teachers during their undergraduate program to foster SRSE.

Statements of Publication Ethics

We hereby declare that the research has not unethical issues and that research and publication ethics have been observed carefully. Ethical approval (approval date: 18.10.2022, and number: 53704) was taken from Ağrı İbrahim Çeçen University.

Researchers' Contribution Rate

The research was conducted and reported with equal collaboration of the researchers.

Conflict of Interest

There is no conflict of interest to disclose.

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The Effectiveness of Technology-Enhanced Language Teaching Methods on Achievement in English: A Meta-Analysis

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Abstract

Integration of technology applications is now an essential part of language education and it has been extensively researched in many experimental studies comparing technology versus non-technology. This study sought to examine the effectiveness of technology-enhanced language instruction for achievement in English and investigate if various study and sample characteristics could moderate the overall effect size. Through a random-effects meta-analysis, technology-enhanced language learning and traditional learning in classroom were statistically analysed based on results from previous experimental studies conducted with Turkish learners of English in Türkiye. The results indicated that learning English with the use of technology is more effective than non-technology in conventional classroom setting with medium-to-large effects on not only overall achievement but also more specific learning outcomes including grammar, vocabulary, and writing. Moderator analyses showed that school level and item type significantly explained heterogeneity across studies. The results are discussed in relation to previous research, and suggestions for further research are given, with a particular emphasis on conducting primary studies in the field.

Keywords: Technology-enhanced language learning, Achievement in English, Meta-analysis.

Teknoloji Destekli Alternatif Öğretim Yöntemlerinin İngilizce Başarısı Üzerindeki Etkililiği: Bir Meta-Analiz Çalışması

Öz

Teknoloji uygulamalarının entegrasyonu dil eğitiminin önemli bir ögesidir ve teknoloji kullanımı ile geleneksel öğretimi karşılaştıran birçok deneysel çalışmada kapsamlı bir şekilde araştırılmıştır. Bu çalışmada teknoloji destekli dil öğreniminin İngilizce başarısındaki etkililiğinin ve birincil araştırmalara ilişkin çeşitli çalışma ve örneklem özelliklerinin ortalama etki büyüklüğünü değiştirip değiştirmediğinin saptanması amaçlanmıştır. Teknolojiyle desteklenmiş dil öğrenimi ve geleneksel öğrenme, Türkiye'de İngilizce öğrenen öğrenciler üzerinde daha önce yürütülen deneysel çalışmaların sonuçlarına dayalı olarak rastgele etkiler meta-analizi yoluyla istatistiksel olarak analiz edilmiştir. Sonuçlar, teknolojiyle desteklenmiş dil öğreniminin, teknolojinin kullanılmadığı geleneksel öğrenmeye göre, yalnızca genel başarı üzerinde değil, aynı zamanda dil bilgisi, kelime bilgisi ve yazma gibi dil öğreniminin daha spesifik yönleri üzerinde orta ila büyük derecede daha etkili olduğunu göstermiştir. Bu kapsamda yapılan moderatör analizleri, okul düzeyi ve madde türünün etki büyüklüklerindeki heterojenliği anlamlı bir şekilde açıkladığını göstermiştir. Çalışmada elde edilen sonuçlar önceki meta-analizler dikkate alınarak tartışılmış ve araştırmacılar için alandaki birincil araştırmalar odaklı öneriler sunulmuştur.

Anahtar kelimeler: Teknoloji destekli dil öğrenimi, İngilizce başarısı, Meta-analiz

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INTRODUCTION

Technology has long become indispensable for foreign language education through the application of a vast array of tools, devices and learning platforms. The implementation of technology serves for the purpose of not only assisting the instruction within the school but providing the opportunity to enhance learning outside the school. With more resources and types of technology being available to support L2 instruction throughout the years, the terminology has shifted towards technology-enhanced language learning (TELL) (Chang & Hung, 2019; Dooly & Masats, 2015; Walker & White, 2013).

A major concept in technology integration in order to learn languages is computer-assisted language learning (CALL), which can be broadly defined as "any process in which a learner uses a computer and, as a result, improves his or her language" (Beatty, 2003, p. 7). The development of computer-assisted language learning is closely related to the advancements in other fields such as educational technology and artificial intelligence (Chapelle, 2001). Warschauer (1996) analysed the development of CALL in three periods: (1) behavioural, (2) communicative, and (3) integrative. Gruba (2004) stated that in each of these periods the roles of learners, teachers and computers have undergone transformations. New technological innovations have enabled a more cooperative and creative language learning experience today (Beatty, 2003).

A second central theme is mobile-assisted language learning (MALL). Mobile devices of all kinds have made it possible for learners to utilize a wide range of learning materials to improve their language skills. The strength of mobile learning lies in its tenet of portability, which can be ascribed not only to the available technology but also to learners and learning itself (El-Hussein & Cronje, 2010; Pegrum, 2014). When one is engaged in MALL, one's learning is not bound to the limits of the classroom. When using mobile devices for language learning purposes, learners can engage in more authentic exchanges rather than instructional ones, which contributes to effective learning (Jee, 2011). Kim and Kwon (2012) mention that learners can become more independent by utilising various facilities in terms of materials, activities and resources.

Blended learning is another crucial aspect of how technology is adopted to enhance learning languages. Whittaker (2013, p. 12) argues that "blended learning is the term most commonly used to refer to any combination of face-to-face teaching with computer technology". Garrison and Kanuka (2004), on the other hand, considers blended learning as an efficient merge of traditional classroom instruction with online education, which is informed by the complex dynamics of a particular context. Thorne (2003) also emphasizes the capacity of blended learning in terms of providing an opportunity for learning in an individualized manner. Dudeney and Hockly (2007) uses the percentage of online materials, stating that more of the content (75%) is delivered online while the remaining occurs in conventional classroom settings; however, Whittaker (2013) states that percentages are not useful for an effective blend to take place.

Flipped classroom is a modern instructional approach creating an active learning atmosphere to meet the changing demands (Turan & Akdağ-Çimen, 2020). Unlike in traditional face-to-face education limited to the classroom, flipped learning requires that "students watch or listen to lessons at home and do their homework in class" (Fulton, 2012, p. 13). Bishop and Verleger (2013, p. 1) also viewed flipping as "a new pedagogical method", whereby constructivist and behaviourist theories of learning can be merged. Flipped approach to learning is demanding by nature as it requires transformation in terms of both students' and teachers' responsibilities (McGrath et al., 2017). As students are expected to carry out an active engagement in the process, they need to assume more responsibility for learning (Du, 2018; Jacot et al., 2014) and become autonomous learners (Suo & Hou, 2017). Flipped classroom is demanding for teachers as well since they assume the responsibility of preparing instructional materials that students will use to learn the content at home, which requires time and technological skills (Herreid & Schiller, 2013). Teachers are also expected to continuously support students so that they can act their roles as active and autonomous learners in the process (Evseeva & Solozhenko, 2015). Flipped learning transforms the use of time within the classroom as opposed to traditional instruction. The time spent within classroom must be organised to enable students to actively engage in practical activities (Başal, 2015) and is therefore more student-centred (Mehring, 2018).

Previous Reviews and Meta-Analyses

The effectiveness of language learning with the use of technology has been mostly confirmed by previous meta-analyses. Among early meta-analyses of CALL, Zhao (2003) found that CALL is more effective (d=0.81-1.12) compared to non-technology through synthesizing research into the impact of various technology

applications on the learning of foreign languages such as German, English, Arabic, French and Spanish. Taylor (2006) analysed the effectiveness of L1 glosses by means of CALL in comparison to traditional aids on L2 reading and found that CALL had a large effect size (g=1.09). More recently, Chiu (2013) investigated the effectiveness of CALL in terms of vocabulary learning, reporting an effect size of d=0.745. Grgurovic et al. (2013) meta-analysed 37 computer technology studies on English, Spanish, German, and Japanese as target language. They calculated the mean effect sizes based on different methodological characteristics of the studies, which ranged from 0.021 to 0.423; however, the studies that focused on English as target language yielded medium-sized average effects. In their comprehensive review of studies related to computer-assisted instruction, Sharifi et al. (2018) included 140 studies published between 1990 and 2016, and they found that CALL was more effective in English language learning (d=0.50) than learning through traditional instruction. The scope of three other meta-analyses were specifically related to the effectiveness of computer-assisted learning in Türkiye (Batdı, 2015; Dikmen & Tuncer, 2018; Tomakin & Yeşilyurt, 2013). Tomakin and Yeşilyurt (2013) included studies published between 2002-2010, and found a large effect size (d=1.43) for CALL among Turkish learners of English. On the other hand, Dikmen and Tuncer (2018) analysed the effectiveness of computer-assisted learning on academic achievement in general in studies published over a period of ten years from 2007 to 2017, and they calculated a large average effect size (d=1.043) associated with the use of computer technology in instruction. However, their study was not exclusive to learning foreign languages since studies on achievement in other courses were involved in their meta-analysis. Similar to Dikmen and Tuncer's (2018) study, Batdı (2015) synthesized the findings from studies on academic achievement in various courses, which were published between 2006-2014, and found a large effect size (d=1.13).

There are also meta-analyses concerning the effectiveness of mobile-assisted learning. Sung et al. (2015) investigated the effectiveness of MALL on L2 achievement over 43 studies published between 1993 and 2013, and calculated an average effect of 0.531. Taj et al. (2016) covered the period from 2008 to 2015 and included 13 studies on achievement in English. The effect size in their study was found to be of small size (ES=0.425). More recently and more specifically, Lin and Lin (2019) analysed the effectiveness of MALL on the vocabulary achievement and found a large effect size (g=1.005). The effect of MALL was also depicted from general academic achievement perspective in two other studies focusing on different courses. One such study was conducted by Güzeller and Üstünel (2016), who included 10 studies from 2009 to 2014, and calculated the average effect size as g=0.849 supporting the use of mobile devices in learning. On the other hand, Yıldız-Avcı (2018) meta-analysed 16 studies between 2008 and 2018, and found that mobile-assisted learning was an effective approach with an average effect size of g=0.607.

Meta-analyses on the impact of blended learning on achievement have reported inconsistent results. Three meta-analyses conducted including studies on samples of university students (Bernard et al., 2014; Means et al., 2009; Vo et al., 2017) found low effect sizes (g=0.33, g=0.35, g=0.38 respectively). Two other meta-analyses presented the situation from a national perspective (Batdı, 2014; Çırak-Kurt et al., 2018). Batdı (2014) was limited to nine studies and calculated the average effect size as d=0.66. However, Çırak-Kurt et al. (2018) included 27 studies to analyse the effectiveness of blended learning in comparison to traditional instruction. They found a large effect size (g=1.042), which supports the effectiveness of blended learning with regard to achievement.

Finally, several systematic reviews and meta-analyses have been conducted involving the studies on flipped classroom. In their systematic review, Uzunboylu and Karagözlü (2017) indicated that the number of studies on flipped learning increased as of 2012 and these studies were mostly conducted utilizing experimental design and in higher education settings. Their finding was quite similar to Kozikoğlu (2019) in that the studies were mostly experimental and conducted in higher education. Filiz and Benzet's (2018) review of previous studies were limited to the use of flipped learning approach in foreign language education and such topics as achievement, attitude, academic performance, and writing performance were mostly researched in the studies reviewed. On other hand, there are several meta-analyses in the literature that investigated the effectiveness of flipped learning on achievement. Karagöl and Esen (2018) included 55 studies and found that flipped learning was more effective than traditional instruction (g=0.566). van Alten et al. (2019) included 114 studies which examined the effectiveness of flipped learning in achievement and calculated an effect size of g=0.36. Similarly, Lag and Saele (2019) determined that flipped classroom was superior to traditional learning through the meta-analysis of 272 studies with a mean effect size of g=0.35.

While the studies reviewed above all provide valuable insights into the role of technology applications in the teaching and learning of languages in the contexts of the studies, they have not provided sufficient evidence to

fully understand how effective TELL was for Turkish learners of English for two main reasons. First, the generalizability of the previous studies is limited since they were interested in different foci, either including only an aspect of technology or investigating a certain aspect of language learning. Secondly, although it is well documented that there have been a large number of experimental studies in foreign language teaching in Türkiye (Özmen et al, 2016; Yağız et al, 2016), most of the literature have not been included in previous meta-analyses due to study inclusion criteria and a narrower period of literature included. Therefore, building on this gap in the literature, this study will provide a more comprehensive picture of the effectiveness of various forms of technology in terms of achievement in English for Turkish learners by utilizing a larger sample of previous experimental studies collected from multiple sources of publication, help to identify the patterns, trends and certain discrepancies in the literature to inform future research in the field. Through synthesizing the findings of the previous studies, this study sought to investigate how effective technology-enhanced language learning methods are for the achievement of Turkish learners of English. We address these research questions in the study:

1.What is the effectiveness of technology-enhanced language learning on grammar, vocabulary, writing, and overall achievement?

2.Does the effect of technology-enhanced language learning on overall achievement differ by moderator variables?

It should be noted that the choice of grammar, vocabulary and writing as well as overall achievement was mainly guided by the available literature on technology-enhanced language learning. As meta-analysis builds upon existing literature in order to provide a more comprehensive summary in a particular field, the number of studies that can be meta-analysed is critical to ensure that the results are reliable and generalizable (Borenstein et al., 2009). Besides, Zengin and Aksu (2017) found out that the majority of studies examining achievement in English language learning through technology integration in Türkiye tend to place greater emphasis to vocabulary learning as opposed to other skills. Similarly, Kartal (2020) stated that writing and vocabulary skills were two of the most common areas where technology has been found to be most effective. Therefore, we focus on analysing the effectiveness of technology-enhanced language learning with respect to the most commonly researched outcomes such as grammar, vocabulary and writing as well as overall achievement.

METHOD

Research Design

The impact of technology-enhanced language learning on Turkish learners' achievement in English was explored through meta-analysis. Meta-analysis is a statistical methodology of synthesizing the results of primary studies on a particular subject (Littell et al., 2008). In line with common recommendations for steps involved in the procedure of a meta-analysis (Ellis, 2010; Field & Gillett, 2010; Rosenthal & DiMatteo, 2001), this study is conducted through the following steps: (1) collecting the studies, (2) evaluating them based on the inclusion criteria, (3) coding study characteristics, (4) calculating effect sizes, (5) computing the mean effect size, (6) assessing publication bias and heterogeneity, and (7) interpreting the results within the research field.

Literature Search

The literature search was completed through both national (*Ulusal Tez Merkezi*, *Dergipark*) and international databases or search engines (*ERIC, Taylor & Francis Online, Jstor, ScienceDirect, Ebscohost,* and *Google Scholar*). Keywords utilized in the exhaustive search involved the combination of the following terms in both English and Turkish to address the dimensions of the research questions: *instruction, learning, teaching, computer assisted language learning, mobile assisted language learning, blended learning, flipped classroom, achievement,* and *experimental*. The database search yielded a total of 2356 studies. Following an initial title and abstract screening, we reviewed the rest of the studies using the following criteria for inclusion.

Inclusion Criteria

Studies retrieved from the databases were screened based on several criteria: (1) The publishing date of the study is 2018 the latest, (2) the full text is accessible in either English or Turkish, (3) the study investigated student achievement in English as the outcome measure, (4) the sample is made up of EFL learners in Türkiye, (5) pretest-posttest control group design was employed, (6) the teaching adopted for treatment group is computer-assisted, mobile-assisted, blended or flipped classroom, (7) instruction in the control group is delivered in traditional face-to-face manner, and (8) statistics required for effect size calculation are reported.

After the elimination of the studies that (1) investigated achievement in other subjects and languages, (2) did not include Turkish learners of EFL, (3) did not have a control group, (4) were not accessible in full-text and (5) did not present required statistics for effect size calculation, 52 primary studies were found to be eligible for inclusion in the meta-analysis.

Coding Procedure

First author was the chief coder in the study. After he coded all the studies, they were randomly assigned to four other coders, who coded 13 studies each. Two measures were applied to check the reliability in the coding process. Agreement rate was calculated separately for each set of studies between the researcher and the other coders. Average agreement rate ranged from 88% to 92%. Also, Cohen's Kappa coefficient was calculated independently in each set as in agreement rate. Cohen's Kappa ranged from 0.82 to 0.88 (p<.001), which indicates a high level of agreement (Landis & Koch, 1977). All the disagreements were later resolved through discussion with the other coders.

Calculation and Interpretation of Effect Size

The effect size index employed is Hedges' *g*, which provides a correction for Cohen's *d* value since the latter can be biased with small sample sizes. If a study involved multiple comparisons of achievement including sub-skills, these effect sizes were averaged to compute the mean effect size for overall achievement. However, in the analysis of the effectiveness of TELL on achievement in sub-skills as dependent variable, the effect sizes from the relevant comparisons were retained and used for calculating the mean effect size for a particular sub-skill. Random effects model was preferred as statistical model for this study on the assumption that the true effect may vary across studies (Field & Gillett, 2010). Random effects analysis was chosen also because it makes it possible to make inferences beyond the observed studies (Hedges & Vevea, 1998). Finally, the estimated effect sizes in this study were interpreted in line with field-specific guidelines offered by Plonsky and Oswald (2014), who recommended adopting the benchmarks of small (d=0.40), medium (d=0.70), and large effect (d=1.00) for mean differences between groups (experimental vs. control) since these can be best at explaining the results within the framework of L2 research. All analyses are conducted using meta-analysis packages *metafor* (Viechtbauer, 2010) and *meta* (Balduzzi et al., 2019) in *R software* (R Core Team, 2021).

Publication Bias

Publication bias is considered to present a risk for the validity of meta-analysis (Jin et al., 2015); therefore, the representativeness of primary research in meta-analysis should be considered. In this study, the assessment of publication bias was performed through Begg and Mazumdar's rank correlation test (Begg & Mazumdar, 1994) and Egger's regression test (Egger et al., 1997). Duval and Tweedie's trim and fill method (Duval & Tweedie, 2000) was also implemented in case of an indication of publication bias to correct for a possible bias.

FINDINGS

Study Characteristics

52 primary studies were published between 1994 and 2018. The studies selected were proceedings (n=3), journal articles (n =13), master's theses (n =26) and PhD dissertations (n=10). The instruction mode in the treatment group of the studies were blended (n =5), CALL (n=28), flipped (n=9) and MALL (n=10). Learner samples were pre-school (n=2), secondary (n=7), high school (n=5), English Prep Class (n=26) and university (n=12). Length of treatment were "1-4 weeks" (n=20), "5-8 weeks" (n=22), "9-15 weeks (n=8), and n/a (n=2). The researchers of the studies participated as "one or both of the teachers" (n=34), "none of the teachers" (n=7) and n/a (n=11). Considering the types of teacher effect in the studies, they were the same teacher ((n=31), different teacher (n=10) and n/a (n=11). The achievement tests used were developed (n=31), adapted (n=5), or an existing test (n=16). In the achievement tests, objective (n=29), open-ended (n=11) and mixed type (n=11) items were used. Finally, sample sizes varied: "1-20 students" (n=23), "21-30 students" (n=20) and "more than 30" (n=9).

Main Effect Analyses

Main effect analyses were performed to compute the effectiveness of TELL on sub-skills such as grammar, vocabulary and writing achievement as well as overall achievement, and the results of these meta-analyses are presented in Table 1.

Table 1. Meta-Analytic Results of Effect Sizes

Dependent Variable	*k*	*g*	SE	95% CI	*z*	*p*	*Q*	I^2
Grammar	14	0.600	0.122	[0.361, 0.839]	4.919	<.001	32.119	59.525
Vocabulary	23	0.698	0.084	[0.534, 0.862]	8.331	<.001	41.592	47.105
Writing	10	0.940	0.180	[0.588, 1.293]	5.227	<.001	27.388	67.138
Overall	52	0.729	0.082	[0.568, 0.891]	8.844	<.001	198.985	74.370

In terms of grammar achievement, 14 studies that reported comparisons were meta-analysed to compute the mean effect size of the impact of TELL. The results show a medium effect size (g=0.600, SE=.122, 95% CI: [.568, .862]), which was found to be significant (z=4.919, p<.001). The distribution of these effect sizes was found to be heterogeneous (Q=32.119, p<.001). In the analysis of the effect of TELL on vocabulary achievement, 23 studies that involved comparisons were included in the meta-analysis. TELL was found to have a medium-sized effect on vocabulary achievement (g=0.698, SE= .084, 95% CI: [.534, .862]) and this result was statistically significant (z=8.331, p<.001). Heterogeneity test indicated that the distribution of effect sizes in terms of vocabulary achievement was heterogeneous (Q=41.592, p<.05). The other sub-skill investigated in the included studies was writing achievement, and 10 studies reported the required statistics for effect size calculation in writing achievement. According to the results, the effect of TELL on writing achievement was of medium-to-high level (g=0.940, SE=.180, 95% CI: [.588, 1.293]), which was statistically significant (z=5.227, p<.001). Finally, 52 studies that met the inclusion criteria were synthesized to estimate the overall effectiveness of technology-enhanced language learning methods. The mean ES was calculated as g=.729, SE=.082, 95% CI: [.568, .891] under the random effects model. This result was found to be significant (z=8.844, p< .001), indicating a medium-sized average effect according to Plonsky and Oswald's (2014) rule of thumb for ES classification in L2 research. Forest plots of the studies in each meta-analysis are provided in *Appendix 1-4*.

Table 1 also presents statistics regarding the heterogeneity across the studies included. The distribution of the effect sizes obtained from 52 studies was found to be heterogeneous, (Q=198.985, p<.001) with I^2=74.370 showing a high level of heterogeneity. It was concluded that the differences between the included studies cannot be attributed to sampling errors only. Therefore, moderator analyses were performed to determine whether the effect sizes differ by moderator variables related to study and sample characteristics.

Moderator Analyses

Moderator analyses were conducted to determine if the effect of TELL on overall achievement in English was moderated by study and sample characteristics. The results of moderator analyses are presented in Table 2.

Table 2. Moderator Analysis Results

Variables	*k*	*g*	SE	95% CI		Q_B	df	*p*
				Lower	Upper			
Publication Type						4.346	3	.226
PhD dissertation	10	0.923	.189	.553	1.292			
MA theses	27	0.800	.115	.575	1.025			
Journal articles	12	0.508	.172	.171	.845			
Proceeding	3	0.352	.337	-.309	1.012			
Instruction Mode						7.608	3	.055
Mobile-assisted	10	1.084	.183	.726	1.443			
Blended	5	0.956	.268	.430	1.481			
Flipped	9	0.800	.193	.421	1.179			
Computer-assisted	28	0.540	.110	.325	.754			
School Level						16.255	4	.003
Pre-school	2	0.314	.378	-.427	1.056			
Secondary school	7	0.673	.197	.287	1.059			
High school	5	1.047	.243	.570	1.525			
Prep Class	26	0.947	.104	.727	1.136			
University	12	0.262	.151	-.035	.559			
Researcher Effect						2.966	2	.227
One of teachers	34	0.826	.107	.616	1.037			
None of teachers	7	0.654	.183	.295	1.012			

Unspecified	11	0.486	.172	.150	.822			
Teacher Effect						2.355	2	.308
Different	10	0.833	.163	.514	1.151			
Same	31	0.766	.120	.531	1.001			
Unspecified	11	0.533	.141	.256	.810			
Achievement Test						1.379	2	.502
Developed	31	0.802	.106	.595	1.010			
Existing	16	0.648	.153	.347	.948			
Adapted	5	0.527	.257	.022	1.032			
Items on Achievement Test						7.990	2	.018
Objective	29	0.572	.109	.359	.785			
Open-ended	11	0.954	.165	.631	1.277			
Mixed	11	1.025	.136	.759	1.291			

Publication Bias Assessment

Publication bias was assessed using two statistical tests based on funnel plot asymmetry. Both Egger's regression test and Begg and Mazumdar's rank correlation test were found to be nonsignificant in both meta-analyses on grammar (p=.16, p=.32 respectively) and vocabulary achievement (p=.782, p=.369). For writing achievement, rank correlation test was found to be nonsignificant (p=.107), while Egger's regression test indicated a funnel plot asymmetry (p=.042). Therefore, Duval and Tweedie's trim-fill test was performed for any missing studies, which yielded three studies added. The adjusted effect size as a result of trim and fill test was found to be g=.662 (95% CI: [.271, 1.054]), which could still be interpreted as of the same magnitude compared to g=.940 prior to trim and fill analysis considering Plonsky and Oswald's (2014) benchmarks. Regarding the meta-analysis on overall achievement, rank correlation test was nonsignificant (p=.089). However, as was the case in writing achievement, Egger's regression test was found statistically significant (p=.018) in the analysis of overall achievement. Trim and fill method suggested 10 studies trimmed and filled, which yielded an adjusted effect size of g=0.542 (95% CI: [.340, .714]). However, this did not change the interpretation of the magnitude of the effect in accordance with Plonsky and Oswald's (2014) benchmarks. As a result, it can be concluded that publication bias was not a big concern for the interpretation of the effectiveness of TELL on achievement in English as reported in this study. Funnel plots of the studies in each meta-analysis are provided in *Appendix 5*.

DISCUSSION & CONCLUSION

The current study aimed to examine the effects of TELL on achievement in English among Turkish learners of English. We also anticipated a variability in effect sizes across studies and performed moderator analyses to understand whether the effects vary by study and sample characteristics. The results revealed that TELL brings medium to large positive effects to learning English among Turkish learners of English. This is a similar finding when compared to other meta-analyses conducted previously.

The high effect size (g=1.084) found in studies on mobile-assisted language learning was in line with other meta-analyses (Güzeller & Üstünel, 2016, Lin & Lin, 2019), showing that mobile-assisted language learning can indeed increase the achievement of learners of English. On the other hand, our finding was higher than those found in two other meta-analyses (Sung et al., 2015, Taj et al., 2016), in which medium-sized effects were found for mobile-assisted language learning. Regarding blended learning, several previous studies concluded blended learning had a low effect on achievement (Bernard et al., 2014, Means et al., 2013, Vo et al., 2017). In the current study, blended learning had a medium to high effect size (g=0.956), which is quite similar to the result of Çırak-Kurt et al. (2018), in which primary research in Türkiye was synthesized with the aim of examining the impact of blended learning (g=1.042). This indicates that blended learning has a high potential in increasing the academic achievement among Turkish learners. A medium effect size (g=0.800) was associated with flipped learning studies included in this meta-analysis, which is indeed higher than other meta-analyses reviewed (Cheng et al., 2019, Karagöl & Esen, 2018, Lag & Saele, 2019, Van Alten et al., 2019). They included studies that examined achievement in not only English but other subjects as well, which might show that flipped learning may not be effective in all subject areas. However, two other recent reviews specifically related to language learning reported somewhat similar findings. Arslan (2020) conducted a systematic review of 78 studies and found that flipped classroom was frequently associated with positive results with respect to writing and speaking. Also, Vitta and Al-

Hoorie (2020) reported a somewhat similar effect size of g=0.58 after accounting for publication bias in their meta-analysis. Previous findings related to the effectiveness of computer-assisted language learning reported medium-sized effects on achievement (Camnalbur, 2008; Grgurovic et al., 2013; Sharifi et al., 2018). Our finding is similar (g=0.540) to these meta-analyses. However, computer-assisted language learning was found to have higher effect sizes in some studies (Tomakin & Yeşilyurt, 2013; Zhao, 2003), which both included studies over a shorter span of time than those in this study. In addition, some of the included studies in Zhao's (2003) meta-analysis examined achievement in other languages. This indicates that computer-assisted language learning might have differing effects across various target languages.

Moderator analysis regarding teacher effect indicated that the effect sizes were higher when experimental and control groups were taught by different teachers compared to those taught by the same teacher, albeit not statistically significant. This finding is different from Chang and Lin's (2013) study. In their meta-analysis of web-based English instruction in Taiwan, Chang and Lin (2013) calculated a slightly bigger effect size when the same teacher was employed in both experimental and control groups. However, their finding did not reach statistical difference either, which indicates further studies are needed to fully investigate the potential impacts of who teaches the experimental and control groups.

Our finding regarding the item type in achievement tests as a moderator variable was found to be statistically significant. We found that when achievement is measured based on achievement tests made up of both objective and open-ended items, the effect size is larger, and only open-ended and only objective items yielded lower effect sizes. This finding is contrary to In'nami and Koizumu's (2009) meta-analysis of test format effects. In'nami and Koizumu (2009) identified that multiple-choice tests were easier in both reading and listening compared to tests of open-ended items. However, it should be noted that In'nami and Koizumu's (2009) study analysed the effects of test format in the performance of reading and listening skills, whereas achievement in our study has been operationalized as overall success in English including not only reading and listening but also writing, speaking, grammar, and vocabulary learning as measured in the primary studies.

The implications of these meta-analytic results regarding the effectiveness of different types of technology-enhanced language teaching methods can be examined through the lens of various specific factors including the type of technology used, instructional design adopted and contextual factors. First, it should be noted that the high effect size associated with mobile-assisted language learning suggest that mobile devices are a useful tool to improve language learning outcomes. This might be due to the fact that mobile devices offer students the flexibility to learn anytime and anywhere (Kukulska-Hulme & Shield, 2008), which can in turn enhance motivation and learning (Liu & Chu, 2010). In contrast, a somewhat lower effect size obtained from studies on computer-assisted language learning might have resulted from the fact that computer-assisted language learning is mainly limited to classroom settings, which might restrict motivation and engagement. On the other hand, the implementation of blended learning requires careful instructional design informed by complex contextual factors (Garrison & Kanuka, 2004), which may not always be very well-executed in practice. In the case of blended learning, the higher effect size found in this study as opposed to previous meta-analyses may be due to the unique implementation of blended learning in the studies reviewed, most of which utilized learning management systems specifically designed to complement the coursebooks used, which may have contributed to the effectiveness of blending (Kintu et al., 2017). Similarly, the effectiveness of flipped learning may depend on contextual factors such as learner preparedness and engagement (Li & Li, 2022) as students are typically expected to deal with instructional materials before attending the class to allow for active and interactive learning environment during class time.

The generalizability of the results of this study should be evaluated considering a number of limitations associated with the inclusion and coding of primary studies reviewed. Firstly, we aimed to include as many primary studies as possible that meet the inclusion criteria to minimize publication bias. Nevertheless, it is almost impossible to be completely certain that no studies were left out. Although we included studies from as early as 1994, older studies might not have been available on the databases we searched through. Considering the development of technology and technology use in education over the years, the effects should be interpreted in line with the time span of the included studies. In addition, the achievement tests used in the primary studies have all been examined carefully and coded appropriately. However, it is likely that some items tested multiple outcomes in language learning. This is why the results of the relevant moderator analysis need to be evaluated in line with this potential overlap between multiple skills. Another limitation is related to the moderator analyses in which relevant moderator variables are not reported in some primary studies. For example, the moderator analyses regarding the teacher effect and researcher effect were performed with one sub-group each formed by 11 studies which did not report any information regarding the role of teacher and researcher, so they were coded as

"unspecified". However, the results might have been more complete if the related information had actually been reported in the studies.

In conclusion, our meta-analysis yielded evidence to the superiority of technology-enhanced language learning to non-technology in terms of achievement in English among Turkish learners of English. Based on this result, we recommend English teachers implement technology in their classrooms. However, it is necessary to consider that good teaching requires a careful pedagogical design of how to implement technology (Sharifi et al., 2018). Caution should be exercised by teachers in not only managing the technical aspects of technology use but also identifying the most appropriate approach for their own contexts (Zhou & Wei, 2018). Given the importance of theoretical grounds of how technology is implemented in L2 teaching, we would like to recommend future researchers conduct experimental research studies into the effects of technology use supported with learning strategies. In addition, our findings regarding the methodological and sample characteristics of the studies included seem to indicate that there is room for more research into the effects of technology-enhanced language learning at primary school level, which is critical for the learning in later stages. Future researchers could also conduct more studies to investigate how technology-enhanced language learning influences achievement in reading, listening, and speaking skills since the number of studies that examined these was limited in our meta-analysis, which would further increase our understanding of the effectiveness of technology in learning a language.

Statements of Publication Ethics

The author(s) of this study complied with all the rules specified within "*Higher Education Institutions Scientific Research and Publication Ethics Regulations*". Since this study is a meta-analysis of previously published studies, it does not require ethical committee approval.

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Conflict of Interest

We hereby declare that there is no conflict of interest involved in this study.

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indicates the studies included in the meta-analysis.

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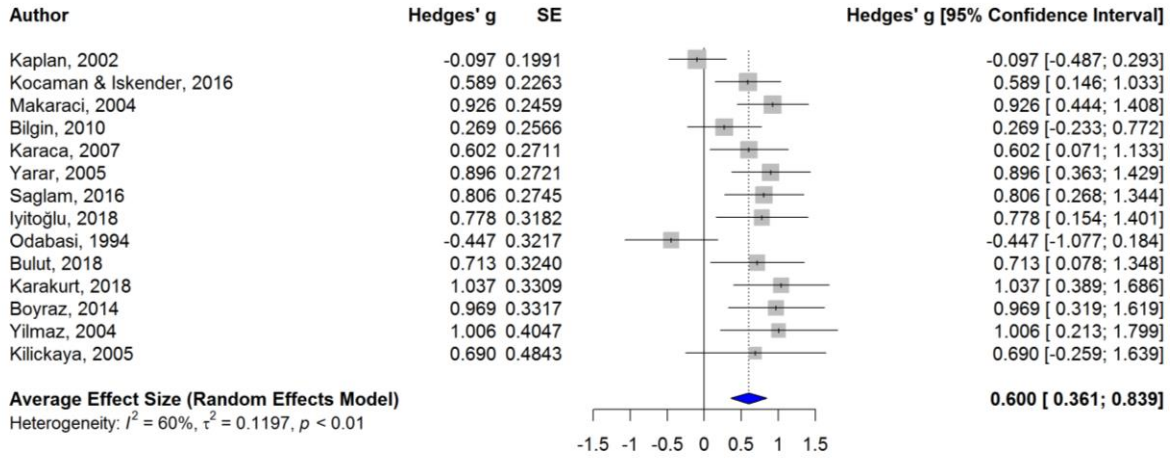
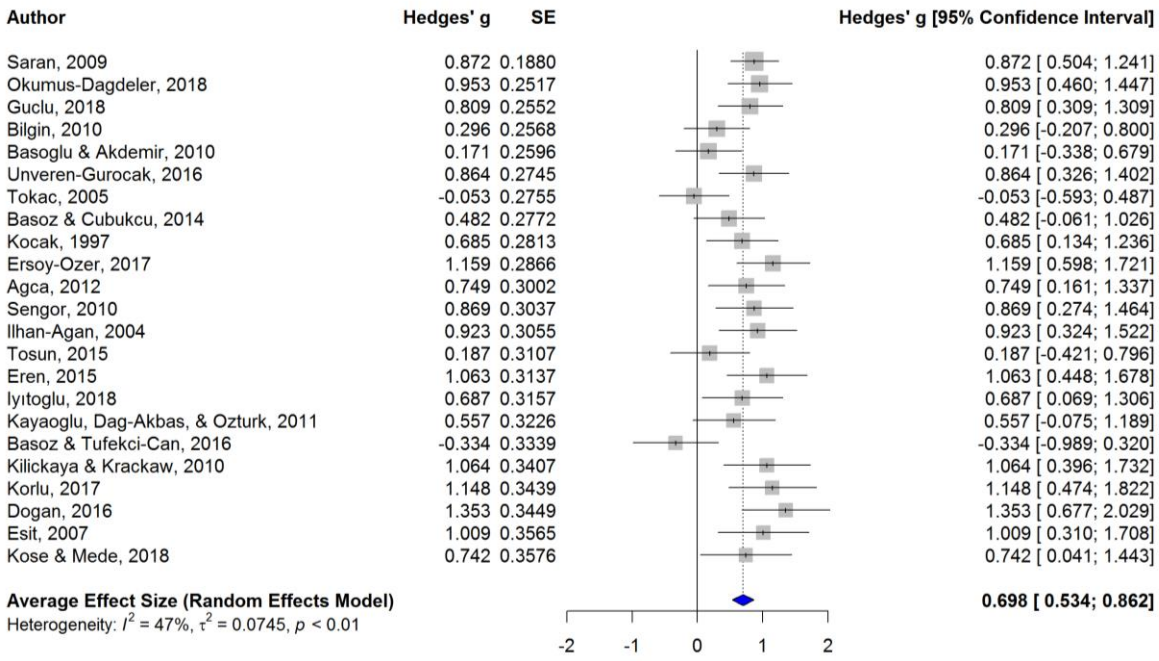
APPENDIX

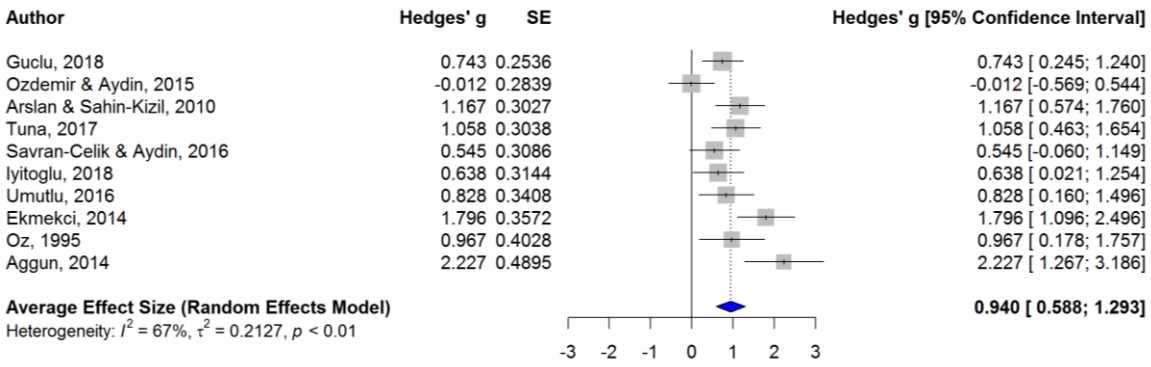
Appendix 1. ***Forest plot of meta-analysis on Grammar Achievement***



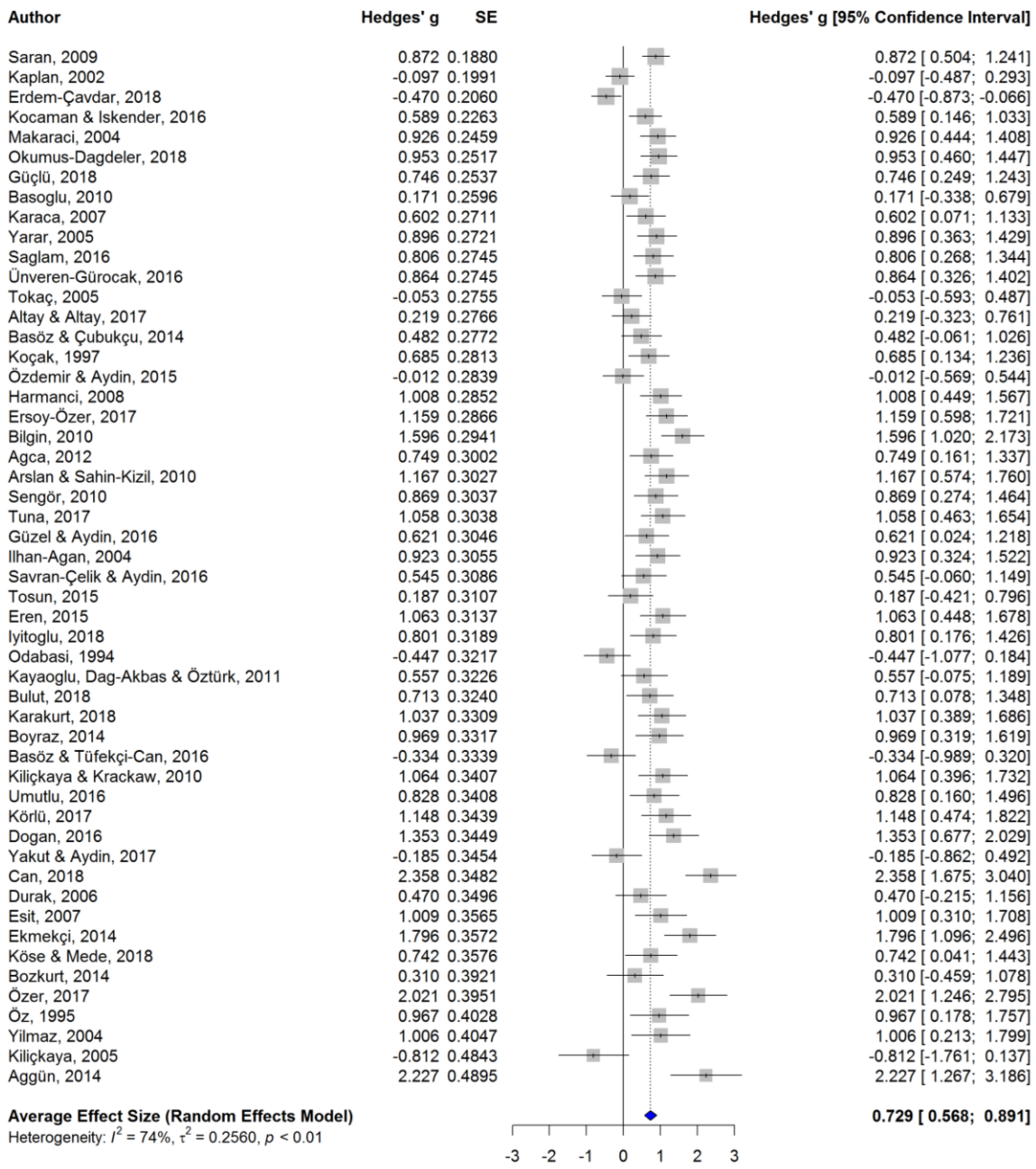
Appendix 2. ***Forest plot of meta-analysis on Vocabulary Achievement***



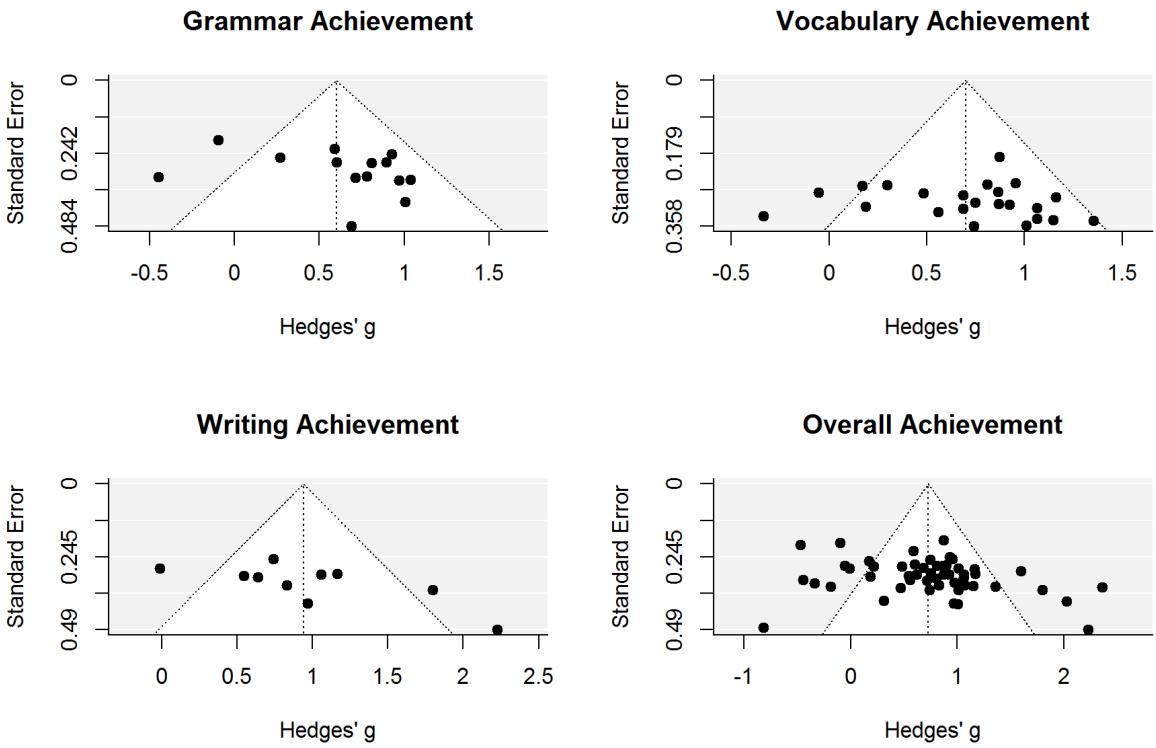
Appendix 3. ***Forest plot of meta-analysis on Writing Achievement***



Appendix 4. ***Forest plot of meta-analysis on Overall Achievement***



Appendix 5. ***Funnel Plots***



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Academic Integrity from the Perspective of Textual Identity: Insights from Pre-service EFL Teachers

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Abstract

Adapting the lens of author identity and the development of textual ownership on academic integrity, the objective of this study, which utilizes a convergent mixed-method design, is to investigate how pre-service English as a Foreign Language (EFL) teachers view authorship and to uncover the factors they believe lead to plagiarism. A total of 46 first-year pre-service EFL teachers participated in the study. To collect both quantitative and qualitative data, a questionnaire was used and responses to scenarios were elicited. The quantitative data were analyzed using descriptive statistics, whereas the qualitative data were analyzed through content analysis. This study revealed that learners had a basic understanding of plagiarism. They emphasized time constraints, heavy workload, and lack of knowledge, fear of failure, motivation, and self-confidence as reasons for violating academic integrity principles. Learners reported having a sufficient understanding of producing their own written work, providing references, and the responsibility of being an author. However, they struggled to express their ideas effectively in written form, which hindered the development of an appropriate authorial identity. This study provides pedagogical implications for enhancing their understanding of authorial identity and preventing plagiarism in tertiary-level language education. Based on these findings, a re-conceptualization of academic integrity discourse, focusing on the developmental perspective and negotiation of identities and values, is suggested.

Keywords: Academic integrity, pre-service English language teachers, authorial identity, textual ownership

Yazar Kimliği Açısından Akademik Dürüstlük: İngilizce Öğretmen Adaylarının Görüşleri Üzerine bir Araştırma

Öz

Akademik dürüstlüğü, ikinci dil ediniminde yazar duruşu ve metin sahipliği gelişimi bağlamında inceleyen bu araştırma yakınsayan karma desenle tasarlanmıştır ve İngilizce öğretmen adaylarının akademik dürüstlüğe dair görüşlerini incelemeyi; akademik dürüstlük ilkelerinin ihlal edilmesindeki olası nedenlere dair bakış açılarını ayrıntılamayı amaçlamıştır. Çalışmanın katılımcıları İngilizce öğretmenliği bölümü birinci sınıfta öğrenim gören 46 öğretmen adayından oluşmaktadır. Sormaca yoluyla toplanan nicel veriler betimsel istatistiklerle, katılımcıların senaryolara verdikleri yanıtlarla toplanan nitel veriler ise içerik analizi yöntemiyle incelenmiştir. Araştırmanın sonucunda öğrencilerin yazar duruşu ve akademik dürüstlüğün bağdaştırılması konusunda temel düzeyde bir bakış açılarının olduğu saptanmıştır. Öğrencilerin akademik dürüstlük ilkelerine uymama konusundaki sıraladıkları nedenler arasında ağır iş yükü, ödevlerin tamamlanması için verilen kısıtlı süre, hata yapma korkusu, bilgi, motivasyon ve özgüven eksikliği olduğu bulgulanmıştır. Öğrencilerin yanıtlarından yola çıkarak yazma süreçlerinde kendi görüşlerini açıklama konusundaki yeterliliklerinin az olmasının bir yazar duruşu oluşturmada engel olduğu sonucuna ulaşılmıştır. Bu bulgulardan yola çıkarak öğretmen adaylarının akademik dürüstlük ilkelerine bağlı kalarak yazar duruşunu anlamalarını sağlama ve yazar duruşu konusundaki bakış açılarını zenginleştirme konusunda öğretim önerileri açıklanmıştır. Bu bulgular ve tartışma noktaları ışığında, akademik dürüstlük konusundaki söylem kalıplarının ve özelliklerinin yazmanın sosyal bir eylem, kimliklerin sunulması ve değerlerin açıklanması olarak düşünülmesi yoluyla yeniden kavramsallaştırılması önerilmiştir.

Anahtar kelimeler: Akademik dürüstlük, yazar duruşu, İngilizce öğretmen adayları, metin sahipliği

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INTRODUCTION

Academic integrity has been a crucial concept that holds both global and local significance within the context of higher education. It has become a matter of profound public concern (McCabe & Pavela, 2000), triggering contemporary discussions and challenges across several disciplines and institutions (Razı & Şahan, 2021). The rise in instances of academic integrity threatens the very essence of education's value (Çelik & Lancaster, 2021) and clashes with the fundamental goals of higher education (Romanowski, 2021).

In the literature, different dimensions of violating academic integrity have been critically acknowledged. To address learners' violations of academic integrity principles, a variety of terms and types have been suggested such as inappropriate text borrowing, falsification, academic dis/honesty, falsification behaviors, cheating, and academic misconduct. Other instances encompass the invention and distortion of research results, mismanagement and inadequate documentation of data, misrepresentation of information, creation of fraudulent data, and failure to attribute contributions (Claxton, 2005). Among these, the concept of academic integrity takes a developmental stance emphasizing the internalization of moral values like honesty and integrity (Smith, 2022, p. 2). This study adopts academic integrity as a foundational concept and contextualizes plagiarism within the framework of development (Kaposi & Dell, 2012). Building upon this foundational framework, this paper aligns with the notions of the intersection between academic integrity and authorial identity.

The violation of academic integrity has been conceptualized as intentional and intentional. Intentional plagiarism refers to copying or paraphrasing information without citing the original source (Strangfeld, 2019). Unintentional plagiarism pertains to learners' unfamiliarity with citation practices and their indecisiveness of whether an idea belongs to them or is taken from another source (Strangfeld, 2019). Previous research documented grounds and connections between academic integrity and underpinning reasons behind the violations of it. Underlying reasons are reported to be time restriction, lack of language proficiency, overemphasis on assignments, peer pressure (Strangfeld, 2019), the pressure of heavy workloads (Pennycook, 1996), source attribution confusion (Breen & Maassen, 2005), and the complexity of assignments (Schrimsher et al., 2011).

Violations of academic integrity have been viewed as a significant indicator of writing development (Pecorari & Petrić, 2014). The most commonly reported issues in writing include the challenge of effectively conveying learners' ideas in their own words, creating a compelling authorial identity, mastering paraphrasing, and ensuring proper citation (Abasi et al., 2006; Ellery, 2008). This case pertains to textual plagiarism, which is "an issue of authorial identity in terms of students' perceptions of who they are as writers" (Abasi, Akbari & Graves, 2006, p. 114). This standpoint argues the need to treat plagiarism as a matter of "learning and development rather than as moral transgression" (Pittam et al., 2009, p. 154). This line of thought proposes a shift towards a discourse of the development of authorial practices like rhetorical intertextuality, which should be taught as an ongoing process that "needs to be nourished and contextualized" (Howard & Jamieson, 2021, p. 401). In the landscape of authorial identity, plagiarism is widely recognized as often unintentional (Pittam et al., 2009). Building on this perspective, writing encompasses the reflection of the writer's identity and self-understanding (Kang, 2017). In this case, writers establish their credibility by presenting an identity that exudes authority and conviction in their evaluations (Hyland, 2002). Relatedly, an authorial writer is considered to value writing, have confidence in writing, take ownership of the text, embrace author identity, and have rhetorical writing objectives (Cheung et al., 2018).

Embracing the developmental view of academic integrity, which encompasses "intent, interpretation, and the nature of the academic community" (Kaposi & Dell, 2012, p. 822), this study employs an inter-textual approach, viewing writing as a social practice. This approach offers insights into misconceptions, attitudes, and perceived motivations underlying violations of academic integrity (Howard & Jamieson, 2021). This study integrates the perspective of authorial identity into academic integrity because the exploration of authorial identity directly engages with the educational practices central to upholding principles of academic honesty (Pittam et al., 2009). Academic integrity as a central concern in tertiary-level language education has attracted substantial scrutiny within the Turkish educational context. (Akbulut et al., 2008; Eret & Ok, 2014; Güzel & Razı, 2018; Kaçar & Işık-Güler, 2021; Razı, 2015; Razı & Şahan, 2021; Yıldırım & Razı, 2018). Among these, one line of research documented factors influencing the tendencies of pre-service teachers to plagiarize online and the causes of plagiarism (Eret & Ok, 2014). They documented that time restrictions, workload, and perceived difficulty of assignments are reasons triggering plagiarism incidences. Institutional policies, peer pressure and individual factors which include psychological and social factors were found to be causes of internet-triggered academic dishonesty (Akbulut et al., 2008).

Recently, Çelik and Razı (2023) examined the impact of writing instruction which aims to train students to enhance technical, moral, and rhetorical intertextuality skills to eliminate plagiarism cases among Turkish secondary school students. They noted that this instruction was useful in alleviating plagiarism incidents and facilitating writing practices such as delivery of the content, style, and organization. Prior studies also documented potential causes of academic dishonesty in higher education. For example, Neumann, Leu and McDonough (2019) investigated challenges faced by L2 learners while using sources in their writing. Examining essays and interviews, they documented that plagiarism stems from the lack of comprehension of the target texts, failure to refine sources, and incorporating them into their writing through proper paraphrasing and citation. In their review article, Pecorari and Petric (2014) noted that a growing body of research focuses on terminological discrepancies, opinions regarding the significance of textual plagiarism in language acquisition, different understanding, and disciplinary variations in the perception of plagiarism. Given the diverse perspectives within the literature, there arises a need to examine L2 learners' awareness and understanding of academic integrity, particularly at the intersection of academic integrity and the development of authorial identity.

Significance of the Study

In tertiary-level language education, ensuring academic integrity continues to be a significant and contemporary aspect, and violations of academic integrity are widespread across different programs. Specifically, understanding plagiarism among pre-service teachers is significant since they become the "gatekeepers of academic honesty in their future roles as teachers" (Romanowski, 2021, p. 2). To address this emerging need, it is necessary to gain insight into their perspectives on authorship and to provide guidance on improving their authorial identity and promoting their knowledge to ensure academic integrity in written works.

Previous research has focused on authorial identity as s theoretical framework, which was formed by analyzing learner viewpoints (Abasi et al., 2006; Pittam et al., 2009), and serves as the foundation for the elimination of plagiarism. To address academic integrity and provide suggestions to prevent violations of its principles, we need to decipher learners' perceived reasons along with influential factors. According to Howard and Jamieson (2021), providing training to learners to enable the establishment of authorial identities yields long-lasting outcomes in eliminating plagiarism practices. Thus, adopting a perspective at the intersection of authorial identity and academic integrity could provide insights into the role of textual ownership development from a developmental perspective. Accordingly, the present study would provide insights into the learners' understanding of the grounds and connections between academic integrity and textual ownership.

Research Questions

The purpose of this study is to explore pre-service EFL teachers' stances towards the intersection of textual authorship and academic integrity and examine their perceived reasons for violating the principles of academic integrity at the tertiary level. Addressing the viewpoints regarding the multi-faceted nature of academic integrity, the following research questions were formulated:

1. How do pre-service EFL teachers perceive the concepts of authorship and textual ownership that surround the landscape of academic integrity?
2. What are their perceived reasons for violating principles of academic integrity?

METHOD

Research Design

Drawing on the mixed methods paradigm, this exploratory study addresses a convergent mixed-method design to decipher a composite picture of the participants' understanding of academic integrity in higher education. This type of design enabled the collection of quantitative and qualitative data in parallel and their analysis separately. After the data collection stage, the results were merged to reveal a composite picture of the research problem (Creswell & Creswell, 2018). In this study, the Student Authorship Questionnaire (SAQ) developed by Pittam et al., (2009), which formed the quantitative data of the study, was used to elicit responses from pre-service English language teachers about their understanding and perspectives of academic integrity. For the qualitative data, Avoiding Plagiarism Scenarios (2015) was used to gather their evaluation of the scenarios by focusing on assessing the severity of the behavior and whether a particular action constitutes academic misconduct. The

rationale behind using both forms of data collection tools is to provide a complementary and composite picture of the intersection between their conceptualization of authorship and academic integrity. This intersection could establish grounds for and connections between how they perceive textual authorship in the landscape of academic integrity. To support this source of data, the participants were asked to reflect on the reasons of plagiarism incidents and whether they read the writing skills course policy about plagiarism.

Participants

This study was conducted in an EFL context at a Turkish state university. Convenient sampling was used to recruit participants. A total of 46 first-year pre-service EFL teachers voluntarily participated in the study after completing writing skills course delivered by the researcher. The writing skills course, which adopts a process-genre-based approach, was delivered during the spring semester of 2022. In the course syllabus, they were provided with an academic integrity policy statement, including the definition of plagiarism and the types of academic integrity violations. At the beginning of the semester, they were also provided with a sample demonstration of similarity detection on Turnitin, which is similarity detection software. Upon completion of the course, a questionnaire and evaluation of scenarios were shared with 62 students. As part of the ethical principles, participants were informed about the confidentiality and purpose of the study through a consent form.

Data Collection and Analysis

The Student Authorship Questionnaire (SAQ) developed by Pittam et al. (2009) was administered to the participants voluntarily. This data collection instrument contained 17 items with a five-point Likert-type scale ranging from 1 (strongly agree) to 5 (strongly disagree). The items focused on eliciting participants' understanding of authorship, authorial identity, and approaches to writing. More specifically, the questionnaire items address "aspects of authorial identity (confidence in writing-items 5, 6, 12, 15, 16; understanding authorship-items 1, 2; and knowledge to avoid plagiarism-items 3, 4, 8), and reflect approaches to writing (pragmatic-items 10, 11, 17, 18; top-down-items 7, 14, and bottom-up-items 9, 13)" (Pittam et al., 2009, p. 162). The reliability of the original questionnaire was "0.69 for confidence in writing, 0.62 for knowledge to avoid plagiarism, and 0.46 for pragmatic approach to writing" (Pittam et al., 2009, p. 163). Additionally, selected scenarios (from the Leland Speed Library, Mississippi College) were used to elicit their understanding of plagiarism in a concrete way and provide a complementary picture of the topic. The participants were provided with four scenarios (Appendix B) and were asked to identify whether a case is plagiarism and to rate the seriousness of the instances of plagiarism with the elaboration of their perspectives about the underlying reasons. Complete data were included in the analysis and incomplete responses were eliminated.

The data were analyzed in two phases. Initially, the quantitative data revealed from the participants' responses to the questionnaire were analyzed by calculating the mean scores and standard deviations. According to Pittam et al. (2009), higher scores indicate more authorial responses to the items in the confidence in the writing section of the questionnaire, which includes the concepts of understanding authorship, knowledge to avoid plagiarism, and a top-down approach to writing. On the other hand, higher scores denote fewer authorial responses for the items in pragmatic and bottom-up approaches to writing. After the quantitative analysis, the qualitative data revealed from their responses to the scenarios were analyzed. The qualitative data analysis stages suggested by Creswell and Creswell (2018) were followed to elicit the emerging codes and themes. Accordingly, a data-driven strategy was used to develop a list of significant statements, identify the meaning units in learner responses, label emerging ideas through specific codes, and cluster and organize them into broader themes. A peer debriefing technique was used to ensure the credibility of the elicited codes and themes. After the analyses of the qualitative and quantitative data, the results were merged and presented in line with each question. To validate the findings revealed from the qualitative data, a peer debriefing protocol was organized with another researcher to further discuss the interpretations of scenarios and conclusions drawn from them. In the findings section, codes and themes were elaborated, and related excerpts of participants' responses were presented without making any changes in linguistic accuracy and clarification.

Research Ethics

This study followed the guidelines containing the principles and codes of conduct suggested by the American Psychological Association (APA). The required stages set by the institutional ethics committee were followed. To ensure the confidentiality of the study, the responses to the questionnaire and cases in the scenarios were anonymous to avoid collecting any potential information that might have provided identifying information in relation to the respondents' identities. Ethical approval for the study was obtained from the Institutional Review Board of the Institutional Human Sciences Ethics Committee (Approval number: 2022/151).

FINDINGS

Students' Understanding of Authorship and Authorial Identity

The first set of questions examined pre-service EFL teachers' understanding of authorship and their perception of authorial identity. These findings were derived from the participants' responses to the questionnaire items. Analysis of the initial question showed that 51.7% of the pre-service teachers read the course policy about plagiarism, whereas 48.3% did not read or remember the policy. Building on this initial insight, the analysis of the questionnaire results revealed that their definition of plagiarism centered on a conceptualization of the term as stealing, knowledge theft, stealing topics, using/copying someone else's work, unethical concepts, inappropriate, self-deception, violating rights, having bad consequences, and not giving credit to the owner. Further responses to the questionnaire items were classified into related categories based on Pittam et al.'s (2009) categorization of factors in the questionnaire. Confidence in writing (items 5, 6, 12, 15, 16) was about expressing concepts in their own words, enjoying writing in their own words, not finding it difficult to express topic-specific concepts, being confident, and not afraid of the impressiveness of their writing. The findings showed that participants mostly reported positive opinions about their confidence in writing. More specifically, they reported enjoying writing in their own words (M = 4.09, SD = 1.24), knowing what it means to express concepts and ideas in their own words (M = 4.20, SD = .757), and feeling confident about the impressiveness of their essay (M = 3.38, SD = .984).

The pragmatic approach to writing, specifically items 10, 11, 14, and 17, involves strategies for obtaining better grades such as using sources instead of relying solely on their own words, coping with time constraints by incorporating pre-existing material, and including a larger proportion of material from various sources in their assignments. The results indicated that participants reported getting better marks when they used materials from a variety of sources (M = 3.02, SD = 1.215) when getting higher marks by writing an essay with their own words (M = 3.71, SD = .843), and they considered writing an essay as a way of making arguments based on their thoughts about the topic (M = 3.24, SD = 1.069).

In the category of understanding authorship (items 2, 3), the pre-service teachers reported knowing the meaning (M =4.07, SD =.809) and responsibilities (M = 3.98, SD = .812) of being an author. As for their knowledge to avoid plagiarism (items 1, 2, 4, 5, 8), they reported knowing how to provide references in their written texts (M = 3.78, SD = .876) and agreed that they would never be accused of plagiarism (M = 4.18, SD = .806) because they know how to refer to which parts of their written texts are not written by them (M = 3.69, SD = 1.083). A comparison between using a top-down approach to writing (item 7) and a bottom-up approach to writing (9, 11, 13) revealed that they reported considering what to express and searching for related evidence (M = 4.13, SD = .894), while they looked for available material and thought about the ways to put them together (M = 3. 96, SD = .852). Their responses to the other items in this category showed that they reported employing bottom-up processes less in their written products.

Students' Perceived Reasons for Violating Academic Integrity

The findings addressed in the second research question were derived from the responses to the scenarios. Overall, these findings revealed the pre-service EFL teachers' perceived reasons for plagiarism. Analysis of the responses revealed three emerging themes: (a) understanding authorship, (b) knowledge to avoid plagiarism, (c) confidence in writing. Their responses to the scenarios revealed that they provided justifications or rationalization the principles of academic integrity. Their concerns regarding their competencies and affective factors were more widespread. Specifically, they referred to underpinning factors such as fear of making mistakes, lack of self-esteem, motivation, self-confidence, and patience. They also reported concerns about their competencies, such as having a lack of creative thinking skills, no sense of achievement in life, lack of knowledge about the topics in writing, and lack of language expressions to convey their messages. Their reported reasons for violating the principles and rules of academic integrity are provided in Table 1.

Table 1. Pre-service Teachers' Perspectives about the Potential Reasons for Violating Academic Integrity

Time management	heavy workload, loaded assignments time constraints for assignments no willingness to spend time on the assignments

Competencies	laziness lack of creative thinking lack of knowledge having no idea about the subject having no sense of achievement in life lack of information to express themselves
Affective factors	fear of failure feeling demotivated low self-confidence lack of self-esteem lack of moral values lack of patience
Pragmatic justifications	an easier and faster way to complete a written work providing a better understanding of the content difficulty of producing an original work getting a good grade nature of the topics

Regarding the pre-service teachers' responses to open-ended questions in the scenarios, the first scenario elicited reflections about using an automated translation program on the internet. Of the respondents who indicated that this case was a violation of academic integrity, 50 % of them considered it to be serious or moderately serious academic dishonesty. One prominent finding was that 50% of the respondents did not report this case as a crucial violation of academic integrity. As for their reasons, the pre-service teachers considered this case as plagiarism and they were found to provide longer and more elaborated explanations and justifications. The respondents who considered this case as academic dishonesty indicated that using an automatic translation program is unfair, the software creates the sentences by hindering the original work and diversity of ideas, by violating the responsibilities of the writer, and by hindering learning and expression of thoughts, as exemplified below:

The student in the example is avoiding the work they need to put into their assignment by plagiarizing a online translator. Translating online is not inherently bad, translating certain words or lexical chunks might actually help you, but using the translator to try and rearrange the word orders by putting the entire sentence in and presenting that as your work is plagiarism because a software wrote that sentence, not you. (Student 5)

All language has a particular set of expressing thoughts. Thinking in one way then translating it with software would mean someone else would express that idea for you, and I believe that is not honest. (Student 16)

The participants who considered this case as an appropriate writing pattern pointed out that such software programs can make the essay better, help put the work together, provide accurate language use, and enhance the effectiveness of expressions. They also highlighted that the programs are publicly available and that it is not copying a person's work or stealing a piece of information. Some of the respondents referred particularly to the intention of the students in the scenarios as shown below:

I think that it is not plagiarism because the student does not steal the knowledge of other people, they solely use a program to express their knowledge in an easier way. (Student 23)

They also implied a lack of understanding about textual ownership and a weak sense of ownership of written work through their responses. Some learners referred to the violation of academic dishonesty as being committed by a human agent and considered other sources as an acceptable way of forming their written texts. Further, it was revealed that they considered writing a text as a product rather than a process to be completed through multiple stages, as exemplified below:

It's not plagiarism because you write your own ideas and knowledge. The internet helps you to put them together. (Student 41)

I think that it is not plagiarism because the student does not steal the knowledge of other people, they solely use a program to express their knowledge in an easier way. (Student 18)

Scenario two addressed the similarity of work that emerged as a result of the pair work and collaboration on an assignment. The majority of them (57.1 %) did not acknowledge this as academic dishonesty and 91.7 % of the participants considered this case as moderately serious or not serious at all. The majority of the respondents highlighted that this case cannot be treated as plagiarism because it is collaboration, inspiring and scaffolding each other, interacting, and exchanging ideas. They also put a specific emphasis on the course instructor's guidance to work together and on the nature of group work by legitimizing a proportion of their work, as illustrated below:

I think this is not plagiarism. Because most of work belongs to me and it is allowed to discuss the problem so I think this is natural to offer some identical portions. (Student 10)

In line with this finding, some of them considered the nature of collaboration as a reason and result of plagiarism, as exemplified below:

Having been given instructions for group work beforehand makes it quite natural for such situations to occur (Student 22).

Afterall there is an aim of encouraging collaboration, so it doesn't count as plagiarism. Except the scenarios where the assignment should be done by individuals (Student 13).

The participants who considered this case as plagiarism emphasized the unequal distribution of work and the need to submit their own original work. They also highlighted the necessity of fair and equal contribution of the pairs and the differences in the expression of ideas and structuring of the style.

It is plagiarism because in group works everyone should do some work. Everyone should be equal. When I use my group members' findings or vice versa, this is stealing (Student 8).

I think collaboration is important but until a certain point. Students must do equal work (Student 16).

Scenario three examined pre-service teachers' perspectives about the acceptability of submitting work completed from another class. This scenario required them to consider whether submitting a paper assignment is similar to the one submitted in another class violates the principles of academic integrity or not. Their responses showed that 17.9 % of them did not consider it plagiarism, 14.3 % are not sure and 67.9 % thought that it was plagiarism. In terms of the severity of its seriousness, 44 % considered it a very serious action whereas 32 % considered as moderately serious, 24 % considered it not serious at all. Considering their reasons for considering it as not plagiarism they thought that anyone has the right to do everything with their work, it is not similar to submitting someone else's work, the background information and cognitive effort and processes belong to the same person. A number of misconceptions about textual ownership were uncovered through their responses as shown in the examples below:

This is not plagiarism as everything belong to me. even if I change the sentences, they are written by me and I think I can use them everywhere as long as sentences are belonging to me (Student 44).

Because it's not someone else's work. It's mine and I should be allowed to use my own work however i see fit. And if the subject is the same for both classes, it's just unnecessary to write another paper. Also, if you realize both your papers are similar, it's hard to change your own verbalization to make them look different and it's very unnecessary and is just time consuming. (Student 6).

The pre-service teachers considering this act as plagiarism pointed out that it is not ethical and fair, it is stealing your own work and self-plagiarism, it is recycling the work without citing, and there is a necessity to change the verbalization of the original work. They also highlighted the need to present an original work as exemplified below:

It is complete plagiarism. First, no allowance is given to use my work. Secondly, there is no citing either referring. Besides, I think this is disrespectful (Student 3).

Even though I will be able to use my own work, it can still be count as a plagiarism. It is same as using someone else's work and changing its cover and a few sentences. Just because it is written by me doesn't mean I can plagiarize myself (Student 24).

The most surprising result emerging from this study was the responses to scenario four, which addressed whether making a friend edit their work by developing new arguments, clarifying their written products, and providing major contributions to make the essay more persuasive violates academic honesty or not. Overall, 42.9 % did not consider this case as a violation of the principles of academic integrity whereas 32.1 % considered it as academic dishonesty. They further elaborated that this case refers to a reciprocal collaboration that enables them to learn and get inspiration and feedback from each other. They also noted that it is not similar to providing identical products, rather it is accepting help from a voluntary friend, as shown in the following responses:

I think this is not plagiarism because she re-writes sentences and she is volunteer about it. (Student 41)

Those sentences and the content belong to me. Needless to say, I didn't get anybody else's work. I don't think it is bad that if one of my friends help me out looking over my paper or correcting some places in it. My friend can help me out on the condition that he/she won't write it over again with their own ideas, only then it would be plagiarism. (Student 12)

The pre-service teachers considering this case as academic dishonesty were found to provide further justification and the necessity of providing original work. They also referred to the need to provide references and give credit to the original work as shown below:

It is a plagiarism since this is the same situation as using someone else's sentences and work without giving them credits and expressing them as source (Student 45).

It is plagiarism because in addition to our own work, there are also the sentences of our friend. It would be more appropriate for our friend to share his suggestions with us instead of rewriting and for us to blend and write according to our own style (Student 21).

Different from these responses, some respondents referred to the writer's intention in providing and getting help with their assignments. The following response indicates the moral values of helping each other without providing major contributions.

If she only gave advice on what and how should i change the crooked parts, it wouldn't be plagiarism because that would be an actually good chance to learn and develop myself which is the moral aim of the assignments. But writing some parts of my homework by his own and even adding some extra arguments is little too much to be considered as innocent. (Student 32)

DISCUSSION & CONCLUSION

This study explored pre-service English language teachers' reflections on the grounds and connections of textual authorship in the context of academic integrity and their insights into reasons for violating academic integrity. The results showed that while more than half of the participants reported reading course policy statements for academic integrity, the others did not. Pre-service teachers shared their responses, indicating a foundational understanding of academic integrity. They noted that they were comfortable with their writing and that they prioritized obtaining better scores using a variety of sources.

To gain further insight into the participants' reflections on the causes of academic integrity violations, their responses to avoiding plagiarism scenarios were examined. Three themes emerged: (a) an understanding of authorship, (b) knowledge to prevent copying, and (c) self-confidence in writing. They expressed their views centered on a balance between top-down and bottom-up writing processes and indicated an understanding of plagiarism elimination techniques. Their responses indicated a preference for considering the content and searching for evidence over focusing on material integration. While sharing their positive attitudes towards expressing concepts in their own words, they highlighted concerns regarding affective factors, such as fear of making mistakes, low self-esteem, lack of willingness, and confidence in writing.

Another prominent finding was their differing perspectives on the use of automated translation software for writing. While some participants reported benefits such as improving linguistic correctness and efficacy, others considered them unethical ways of completing written work. They were found to legitimize the use of these tools as a way to provide accurate language use, to enhance the effectiveness of their expressions. Surprisingly, some learners referred to the violation of academic dishonesty through human agency; nevertheless, they considered using other sources as an acceptable way to form their written texts. Since learners face persistent challenges in understanding, selecting, and integrating source information (Neumann et al., 2019), providing training on automated paraphrasing tools and enhancing their detection is needed (Roe & Perkins, 2022). Further programs designed to enhance academic writing skills could potentially eliminate plagiarism (Perkins et al., 2018).

This study shown that they provided their perceived reasons for violating the principles of academic integrity in relation to several factors of time management, competencies, affective factors, and pragmatic justifications. This study provides evidence in relation to the reasons for violating the principles of academic integrity. These practices were found to be motivated by helping friends, social norms governing this behavior, time pressure, peer pressure, increasing course grades, fear of failure, laziness, lack of deterrence, and competitiveness (Devlin, 2003; Franklyn-Stokes & Newstead, 1995; Noah & Eckstein, 2001; Park, 2003). Learners are expected to fulfill multilayered requirements of writing due to the need to establish a stance towards their propositions, get behind their words, and adopt an authorial stance (Hyland, 2002). This may pose a stumbling block in the learners' construction of an authorial identity unless they are provided with ways and strategies to achieve these goals and meet the requirements. Examining learners' construction of authorial voice through citations, Sun et al. (2022) revealed that the underlying elements influencing these practices include are language proficiency, reading skills, subject knowledge, commitment, and time constraints in writing, knowledge construction, and self-beliefs. Enhancing these practices and considering the underlying elements could help

strengthen the connection between adopting an appropriate authorial identity and ensuring academic integrity in writing. To overcome the aforementioned challenges, previous research proposed the integration of positive ethics framework (Gregory, 2021; Howard & Jamieson, 2021) and suggested a shift from asking "Is this good enough?" to "Is this the best it can be?" (Pecorari & Sutherland-Smith, 2021, p. 308).

Regarding reflections on textual ownership, the participants reported a preference for employing a top-down approach, involving contemplating ideas and seeking relevant evidence. There was less emphasis on employing a bottom-up approach that pertains to working with available materials. In previous research, learners' lack of knowledge about writing a specific genre (Rocha-Erkaya, 2009), and their lack of language proficiency to express their viewpoints (Pecorari & Petríc, 2014) were reported to be potential reasons for their violations. Another intriguing finding was the differing perspectives of peer-collaborated academic dishonesty. While some participants reported getting a significant contribution from a friend in the written work is a violation of academic integrity due to a lack of originality, others viewed it as collaborative work. Challenging these entrenched fallacies, providing genre exposure, and enhancing critical thinking skills could make major contribution to authorial identity development (Yeh, 2021).

The learners' lack of awareness of the types of violating academic integrity strengthens the idea that awareness-raising activities on the forms of plagiarism and representation of an authorial stance in writing are crucial components in higher education. Higher education institutions mainly use deterrent interventions and penalties to overcome violations of academic integrity although there is no consensus on the correct behavior (Gregory, 2021). Nevertheless, punishment may not be a useful strategy for changing learners' perceptions of academic dishonesty, because those who did not encounter negative consequences for academic dishonesty did not have higher rates of academic dishonesty than those who did not (Ives, 2017). Discussions surrounding preventive actions should be reconceptualized. In this regard, adopting an intertextuality-oriented writing pedagogy could help eliminate plagiarism incidents (Çelik & Razı, 2023). Proposed by Howard and Jamieson (2021), this approach supports rhetorical intertextuality by teaching learners to "write from sources rhetorically, in a dialogue that involves themselves, their sources, and their audience" (p. 397). This perspective suggests positive ethics and prioritizes engagement of students in interaction with texts and their sources (Howard & Jamieson, 2021). Another effective policy could be considering learners as members of the academic community (McNeill, 2022).

In higher education institutions, guidelines have been proposed to cultivate the conventions of paraphrasing, quoting, and summarizing to ensure honesty and integrity in writing. Further, higher education institutions could develop strategies to cultivate a deeper understanding of authorship, highlighting the importance of original work, and offering advice on ethical writing techniques. Adopting a developmental perspective on academic integrity could also lead to long-lasting effects. Specifically, to eliminate breaches of academic integrity, learners should be viewed as authors rather than violators of principles and moral values (Howard & Jamieson, 2021). Although the intentional and unintentional dichotomy provides insights into academic dishonesty, it mirrors outcomes of entrenched inequalities grown across K-12 educational histories (Strangfeld, 2019). Thus, we need the dissemination of clear guidelines, course policies, and appropriate practices across different grade levels. Further, fostering learners' academic literacy skills can be facilitated through the employment of academic integrity policies and enhancing the development of textual ownership. Notably, we need a reconceptualization of the discourse of academic integrity with a particular focus on the role of academic literacies as a social practice (Thacker, 2022) and negotiation of identities.

As a further study, the educational philosophies of the institutions and the previous academic experiences of the learners may be the subject of future studies. Future research could investigate how cultural differences and contextual factors affect how academic integrity is perceived and examine the efficacy of initiatives to encourage ethical writing among pre-service EFL teachers. Teachers' challenges in their classes and learners' difficulties stemming from their language proficiency and background knowledge of a topic remain to be elucidated.

Statements of Publication Ethics: The researcher followed the ethical guidelines and principles by ensuring the anonymity of participant responses throughout all phases of the study. The participants were involved in the study on a voluntary basis after the completion of the semester to avoid the potential impact of the course instructor and course-related concerns. The study was approved by Sinop University Ethics Committee of Human Research with a decision number 2022/151 on 15.09.2022.

Conflict of Interest: None

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APPENDIX

Appendix A. Student Authorship Questionnaire (Pittam, Elander, Lusher, Fox & Payne, 2009)

		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
1	I know how to provide references for citations and quotations in my written work.	2.2	6.7	17.8	57.8	15.6	3.78	.876
2	I know what it means to be the author of a piece of written work.	0	6.7	8.9	55.6	28.9	4.07	.809
3	I know what the responsibilities of an author are	0	6.7	13.3	55.6	24.4	3.98	.812
4	I would never be accused of plagiarism	0	2.2	17.8	40	40	4.18	.806
5	I enjoy writing in my own words	8.9	2.2	11.1	26.7	51.1	4.09	1.240
6	I find it difficult to express topic-specific concepts in my own words	4.4	31.1	37.8	11.1	15.6	2.98	1.076
7	When writing an essay I begin by thinking about what I want to say, and then look for evidence relating to that.	2.2	4.4	6.7	51.1	35.6	4.13	.894
8	I know how to show which parts of my essay were not written by me.	2.2	17.8	17.8	37.8	24.4	3.69	1.083
9	Doing an assignment is all about finding material in books, journals and the Internet and arranging it in the form of an essay	17.8	22.2	35.6	17.8	6.7	2.73	1.156
10	I just don't have time to put everything in my own words when writing an essay.	24.4	31.1	20	20	4.4	2.49	1.199
11	I get better marks when I use more material taken directly from books, journals or the Internet in my essays.	13.3	22.2	22.2	33.3	8.9	3.02	1.215
12	I know what it means to express a concept or idea in my own words.	0	2.2	13.3	46.7	37.8	4.20	.757
13	When writing an essay I begin by looking for material I can include and then think about how I can put it together.	0	13.3	4.4	60	22.2	3.96	.852
14	Writing an essay is all about making an argument based on my own thoughts about the subject.	4.4	22.2	28.9	33.3	11.1	3.24	1.069
15	I am confident that when I write an essay it will look impressive.	2.2	13.3	44.4	24.4	15.6	3.38	.984
16	I am afraid that what I write myself about a topic in my essay will look weak and unimpressive.	8.9	28.9	31.1	20	11.1	2.96	1.147
17	I get higher marks by writing more of my essay in my own words.	2.2	4.4	26.7	53.3	13.3	3.71	.843

Appendix B. (Avoiding Plagiarism Scenarios, 2015)

Scenario 1: You are in an advanced language class and are stumped trying to write a composition so you write some sentences in English and use an automatic translation program on the Internet to help you out. This is okay, since it's like using a dictionary, and the professor said dictionaries were allowed. Is that academically honest?

Yes
No
Not Sure
a) Why is this or is not plagiarism?
b) If you consider this plagiarism, how serious do you think this is?
Not Serious at all
Moderately Serious
Very Serious

Yes: 44.8% No: 31% Not sure: 24.1%	Not Serious at all : 50% Moderately Serious: 37.5% Very Serious: 12.5%

Scenario 2: Your professor allows collaboration on homework assignments and encourages study groups but still expects you to do your own work. You and two friends discuss the problem and work through it together. Portions of your final work are identical, but that should be okay, since most of the work is your own. Can you be charged with academic dishonesty?

Yes
No
Not Sure
a) Why is this or is not plagiarism?
b) If you consider this plagiarism, how serious do you think this is?
Not Serious at all
Moderately Serious
Very Serious

Yes: 32.1% No: 57.1% Not sure: 10.7%	Not Serious at all: 37.5% Moderately Serious: 54.2% Very Serious: 8.3%

Scenario 3: You notice that a paper assignment in your class is just like one you wrote for another class. You change the cover sheet and a few sentences in the introduction and turn it in. This is okay because it is your own work, right?

Yes
No
Not Sure
a) Why is this or is not plagiarism?
b) If you consider this plagiarism, how serious do you think this is?
Not Serious at all
Moderately Serious
Very Serious

Yes: 17.9% No: 67.9% Not sure: 14.3%	Not Serious at all: 24% Moderately Serious: 32% Very Serious: 44%

Scenario 4: You ask a friend, who is a good writer, to look over your paper. She is happy to help and finds many awkward phrases and ambiguous assertions, which she re-writes for you. She even develops a few new arguments to help support your thesis. You are happy because she was able to express clearly and persuasively what you had been trying to say all along. Is this academic dishonesty?

Yes
No
Not Sure
a) Why is this or is not plagiarism?
b) If you consider this plagiarism, how serious do you think this is?
Not Serious at all
Moderately Serious
Very Serious

Yes: 32.1% No: 42.9% Not sure: 25%	Not Serious at all: 42.3% Moderately Serious: 26.9% Very Serious: 30.8%

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How Concept Cartoons-Supported 5E Model Affects Mathematics Performance and Motivation of Secondary School Students

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Abstract

This study investigates how the concept cartoons-supported 5E model affects secondary school students' mathematics performance and motivation. A pre-and post-test design with a control group (CG) and experimental group (EG), a quasi-experimental quantitative method, was employed in the study. The participants of the study were 7th-grade students of a public secondary school in the Western Black Sea region in the academic year 2021-2022. EG had 16 students, and CG had 18. Concept cartoons prepared according to the 5E learning model were used in EG. On the other hand, CG was instructed according to the curriculum, and there was no concept cartoons-supported exercise. In the study, the 20-question multiple-choice Mathematic Achievement Test prepared by Özkan (2019) and the Mathematics Motivation Scale developed by Üzel et al. were administered to the groups twice as a pre-test and post-test. Mann-Whitney U and Wilcoxon signed-rank tests were employed in the data analysis. As a result of the study, no significant differences were found between EG and CG regarding "mathematics performance" and "mathematics motivation" variables. Several suggestions were made based on study results.

Keywords: 5E Learning Model, concept cartoons, mathematics achievement, motivation, ratio/proportion

Kavram Karikatürleri Destekli 5E Modelinin Ortaokul Öğrencilerinin Matematik Başarılarına ve Motivasyonlarına Etkisi

Öz

Bu araştırmanın amacı kavram karikatürleri destekli 5E öğrenme modelinin ortaokul öğrencilerinin matematik başarılarına ve matematiksel motivasyonlarına etkisini incelemektir. Araştırmada nicel araştırma yöntemlerinden ön test-son test kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırmanın örneklemi 2021-2022 öğretim yılında Batı Karadeniz Bölgesinin bir il merkezinde bulunan resmi bir devlet ortaokulunun 7. sınıf öğrencilerinden oluşmaktadır. Deney grubunda 16, kontrol grubunda 18 öğrenci bulunmaktadır. Deney grubuna 5E öğrenme modeline göre hazırlanan kavram karikatürleri uygulanmıştır. Kontrol grubuna ise öğretim programında belirtilen şekilde uygulama gerçekleştirilmiş olup kavram karikatürlerinin kullanıldığı herhangi bir uygulama yapılmamıştır. Araştırmada Özkan (2019) tarafından hazırlanan 20 soruluk çoktan seçmeli matematik başarı testi ve Üzel ve diğerleri (2018) tarafından geliştirilen matematiksel motivasyon ölçeği kullanılmış olup gruplara ön-son test olmak üzere 2 kez uygulanmıştır. Verilerin analizinde Mann Whitney U testi ve Wilcoxon işaretli sıralama testi kullanılmıştır. Araştırma sonucunda matematik başarısı ve matematiksel motivasyon değişkenleri açısından deney ve kontrol grupları arasında anlamlı bir fark bulunmamıştır. Ayrıca matematik başarı testi ve matematiksel motivasyon ölçeğinden alınan puanlar arasında korelasyon analizi yapılmış ve iki grup arasında anlamlı bir farkın olmadığı görülmüştür. Araştırma sonuçlarına dayalı olarak çeşitli önerilerde bulunulmuştur.

Anahtar kelimeler: 5E öğrenme modeli, kavram karikatürü, matematik başarısı, motivasyon, oran-orantı

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INTRODUCTION

Currently, the methods of the constructivist approach, which involves students taking an active role, are used in teaching (Asan & Güneş, 2000). The constructivist approach is based on students' independent and self-directed learning under the teacher's guidance and structuring the knowledge in mind (Büyükkarcı, 2019). The constructivist approach encourages children to structure knowledge in their minds into something that carries meaning. Students satisfy their curiosity by asking questions about the things that pique their interest and engage in the scientific method through open-ended inquiry (Martin, 2000). Today's information and technology societies need teaching methods, techniques, and approaches that aim to raise individuals who can develop solutions to problems, who can reason, and who have the ability to think freely without rote learning (Ünal, 2003). Among these, the 5E Learning Model has an important place. The 5E Learning Model is a five-stage model developed by Rodger Bybee, namely, Enter, Explore, Explain, Elaborate, and Evaluate (Bybee, 2002). Most of the studies conducted in Turkey on the 5E model are concentrated in natural sciences (Hiçcan, 2008).

Fish (1999) states that the 5E learning model significantly improves learning, increases retention in concept learning, develops positive attitudes toward science, enhances the ability to make comparisons, and improves scientific process skills (as cited in Bıyıklı, 2013). Studies using concept cartoons-supported 5E learning models have attracted attention in recent years. They showed that concept cartoons teach concepts effectively and eliminate misconceptions about science. Taşlıdere (2021) conducted a study examining the 5E learning model with concept cartoons in natural science education. In this study, he showed that using concept cartoons with enriched conceptual change texts effectively increased conceptual understanding and reduced misconceptions. According to Çetinkaya et al. (2022), using concept cartoons based on multicultural education in natural science education is an effective educational tool for increasing students' academic performance. Webb et al. (2008) found that concept cartoons can be used in natural science lessons to initiate and enrich classroom discussions. They created a conceptual framework that facilitates the discussion process, making this framework available to students by relating it to concept cartoons. The study's results showed that such an approach improved students' reasoning processes.

Regarding the studies on the 5E learning model, especially those in which concept cartoons support this model, most focus on natural sciences, and the number of studies addressing mathematics and geometry is limited (Yılmaz, 2018). Mathematics education aims to develop students' understanding of mathematics concepts and the ability to make connections between them (Van de Walle et al., 2012). Students must be provided with appropriate learning settings and opportunities to achieve this. Students' failure to construct meaning can lead to various difficulties and misconceptions in learning (Özmantar et al., 2008). Considering this situation and the perception that the mathematics course is challenging, it should be made enjoyable and understandable. Conceptual teaching can be realized with students' active participation in the learning process. One of the ways to do this is to use concept cartoons in mathematics teaching, which have been used in recent years, especially in natural science lessons. Concept cartoons help students develop different ideas and encourage them to research by relating things to their prior knowledge (Kılınç, 2008). Kabapınar (2005) defines concept cartoons as the pictorial illustration of the discussion of three or more characters on a topic. Concept cartoons have many benefits (Dabell, 2004), including revealing students' prior knowledge and ideas, making them critically approach thoughts, letting them develop alternative perspectives, increasing interest and motivation towards the course, enabling them to make self-criticism by creating a discussion environment, developing the skill of advocating their ideas and self-expression, initiating and maintaining discussions, and overcoming misconceptions. A concept cartoon is a method for teaching a concept; it prevents misunderstandings and conveys a scenario through characters (Yurtyapan et al., 2017). Concept cartoons are used to question and criticize knowledge, create discussions, and reach a conclusion by structuring the knowledge (Ören, 2009). Concept cartoons can be used to reveal students' misunderstandings and misconceptions. A teacher who knows his/her students' misconceptions helps them create discussions and scientific research to get detailed information about the concepts using concept cartoons. This way, learning can be maximized, and misconceptions can be corrected (Creswell, 2003).

According to Çelik and Gündoğdu (2016), using concept cartoons in IT courses increases student performance. It ensures retention of what has been learned. Gomez (2014) argues that cartoons, caricatures, and comics are essential tools for developing learning and creativity, making learning enjoyable, and encouraging students to think outside the box. Çil (2014) states that using conceptual change texts supported by concept

cartoons significantly affects the development of primary school students' views about the nature of science. Concept cartoons provide students with different perspectives. Students are allowed to defend their views using practical reasoning. These features and the learning environment created by concept cartoons, which are very effective in initiating discussions, also facilitate student evaluation (Çil, 2014). Atasoy et al. (2020) emphasized that concept cartoons in school hallways effectively improved pre-service teachers' perceptions of informal physics learning, promoted scientific literacy, created an alternative learning environment, and helped them overcome prejudices towards physics courses. Aydın (2015) found that using computer-based concept cartoons positively affected 7th-grade students' light pollution awareness. Özmen et al. (2012) found that laboratory activities enriched with concept cartoons effectively explained acid-base concepts and captured students' attention. Similarly, Balım et al. (2014) took the views of science and technology teachers on implementing a problem-based and concept cartoons-supported learning approach. They found that concept cartoons effectively encourage students' participation in the lesson, create an environment for discussion, and ensure learning retention because they contain visual elements and capture students' interest. Meriç (2014) stated that concept cartoons in science and technology classes have a positive impact on secondary school students' conceptual understanding and motivation related to academic performance and are effective in identifying misconceptions. On the other hand, Meriç (2014) stated in the same study that the groups did not significantly differ according to the use of concept cartoons regarding students' motivation toward research, communication, collaboration, and participation. Similarly, Atasayar Yamık (2015) concluded that concept cartoons did not significantly increase students' motivation to learn natural sciences. Teaching methods supported by concept cartoons, which are more common in natural science, can also be used in mathematics teaching. Concept cartoons can be used in teaching concepts and developing various skills, such as mathematical reasoning and problem-solving.

Research shows that mathematics is one of the most challenging subjects for students to understand and perform. The fact that the mathematics courses are relatively abstract compared to other courses and that young students encounter this class for the first time makes it difficult for them to comprehend. Therefore, using concept cartoons is an excellent way to make mathematics more enjoyable and retain what is learned. (Batdal Karaduman & Elgün Ceviz, 2018). Studies on using concept cartoons in mathematics education have intensified recently (Aygün et al., 2020; Pekel, 2021; Yılmaz, 2018; Yürekli, 2020). However, their number is still low compared to the ones in natural sciences. Dereli (2008) conducted studies on integers, Erdağ (2011) on decimal fractions, Göksu and Köksal (2016) on lines, angles, and polygons, Korucu (2009) on polygons, and Yılmaz (2018) on area and land measurements. Şengül (2011) reported that concept cartoons significantly affected secondary school students' perceived self-efficacy in mathematics, Kaplan et al. (2014) reported that concept cartoons were effective in resolving misconceptions encountered in square roots, and Karahan and Çağanağa (2017) reported that concept cartoons made concepts approachable and increased interest in geometry classes. Göksu and Köksal (2016) emphasized that applying constructivist teaching approaches with concept cartoons in geometry lessons improved students' problem-solving skills, and they could demonstrate what they had learned in performance tasks. The study also concluded that concept cartoons-supported lessons contributed to the development of students' affective, social, and cognitive characteristics through results obtained from interviews with students.

Marques et al. (2023) conducted a concept cartoons-supported STEM experience in a mathematics class with 10th-grade students. The study results showed that the cartoons effectively helped students to learn new concepts in STEM domains. The same study suggested that concept cartoons have pedagogical potential to promote the STEM approach and can be considered an innovative communication source. Pekel (2021) examined how usual and argumentation-based concept cartoons affected students' performance and found a significant difference in favor of the experimental groups. He revealed that the academic performance of the group using argumentation-based concept cartoons was higher than that of the group using usual ones. Aygün et al. (2020) found that applications with concept cartoons contributed positively to students' use of mathematics terms, symbols, and concepts, and using concept cartoons in learning environments is beneficial. In her study on identifying and eliminating misconceptions of secondary school students about integers using concept cartoons, Yürekli (2020) found that concept cartoons partially eliminated misconceptions. On the other hand, based on her observations, she found that concept cartoons increased students' motivation and positively affected their interest in mathematics. Students' motivation is as important as the methods and techniques used in learning. Studies (Glynn et al., 2005; Palmer, 2007) have shown that motivation influences learning. Motivation is the degree of continuity in an individual's attempt to take action and realize his/her goal (Adler et al., 2001). İspir et al. (2007)

defined mathematics motivation as students' active participation in mathematics and willingness to learn. Regarding Palmer (2007), highly motivated students are happy, attentive, and aware of their tasks and responsibilities.

In separate studies conducted with a quasi-experimental model, Yağıcı (2019) and Batdal Karaduman and Elgün Ceviz (2018) reported that effective use of concept cartoons increased 3rd & 4th-grade primary school students' mathematics performance. Yılmaz (2018) found that EG's mathematics performance, in which the concept cartoons-supported 5E model was used, was significantly higher than CG's mathematics performance, in which the instruction was made within the scope of the curriculum. Katipoğlu (2016) used entertaining and humorous cartoons to teach natural numbers to 6th-grade students, concluding that they effectively increased students' mathematics performance. Kaplan and Öztürk (2015) found that using concept cartoons in teaching divisibility and prime numbers to secondary school students increased their mathematics performance. Samkova (2018) stated that concept cartoons were more effective than written texts in eliminating misconceptions about fractions. Regarding secondary school students' mathematics performance, Önal and Çilingir Altiner (2022) found a significant difference between EG and CG, in which concept cartoons and the classical approach were used, respectively. On the other hand, Gökkurt Özdemir et al. (2021) conducted a mixed-methods study using concept cartoons to eliminate misconceptions among secondary school students in mathematics courses. There was no significant difference between groups in eliminating misconceptions. However, qualitative findings indicated that using concept cartoons in mathematics courses made the lesson entertaining; the cartoons captured attention, increased interest in the class, and allowed the visualization of the topics. Güler (2010) used concept cartoons in teaching natural numbers and found that using concept cartoons did not affect 6th-grade students' mathematics performance. Similarly, Korucu (2009) compared the impact of cartoons-used and computer-assisted instruction methods on students' mathematics performance while teaching polygons. The groups did not significantly differ regarding students' mathematics performance.

The feature distinguishing this study from the others in the literature is using a concept cartoons-supported 5E learning model in ratio/proportion teaching. The concept of ratio and the ability to think proportionally are present in every aspect of life. The concept of ratio is mentioned in the relationship between the amount of water and other substances in the human body, the amount of oxygen and hydrogen in the air, and the relationship between force and mass. The concepts of ratio, proportion, and proportional thinking form the basis of many natural science and mathematics concepts (Karagöz Akar, 2010). Therefore, it is crucial to understand this topic. Thompson and Thompson (1994) defined the concept of ratio as "a measurement obtained as a result of the multiplicative comparison of two multiplicities belonging to different measurement spaces." The concept of proportion has been defined by Lamon (1995) as "the equality of two ratios showing the same relationship" (as cited in Karagöz Akar, 2010). The concept of ratio/proportion in mathematics is the basis of many subjects. Most topics in the mathematics curriculum (MoNE, 2018), such as motion problems, measurement, fractions, probability, percentages, and similarity, are related to ratio/proportion. Secondary school students' mathematics skills related to ratio/proportion affect their success in other courses. Therefore, it is crucial to explore students' level of associativity in ratio/proportion topics (Yakar, 2020). MoNE (2005, 2009) states that the concept of proportion in mathematics curricula should not only be considered as equalizing two ratios or finding the term that is not given; it also includes recognizing proportional quantities and multiple representations of relationships between quantities as numbers, tables, graphs, and equations. In addition, these curricula also include statements that proportion is an essential tool for integrating many basic mathematics concepts and that students use proportion in some linear equations, scales, and finding the ratio of circumference to diameter. Therefore, this study is significant in using concept cartoons in mathematics education and visualizing the topic of ratio/proportion through concept cartoons. In this study, the topic of ratio/proportion was illustrated through concept cartoons and made attractive to students. No study was conducted with 7th-grade students using concept cartoons-supported 5E model on ratio/proportion in the relevant literature. Based on the thought that using different methods in teaching mathematics, in which students are active and learn by having fun, is essential, this study aims to investigate how concept cartoons-supported 5E model in teaching ratio/proportion topics affects students' performance and motivation. In addition, it is hoped that the concept cartoons, the teaching materials proposed in this study, would be used by students, pre-service teachers, and teachers. In this regard, this study contributed to the relevant literature in this context.

This study focuses on the effect of teaching ratio/proportion using the concept cartoons-supported 5E model on 7th-grade secondary school students' mathematics performance and mathematics motivation.

Research Problem

How does using the concept cartoons-supported 5E model in teaching ratio/proportion topics affect the mathematics performance and motivation of 7th-grade students?

Sub-problems of the study:

1.Is there a statistically significant difference between the MAT scores of EG taught with the concept cartoons-supported 5E model and that of CG taught according to the current curriculum (MoNE, 2018)?

2.Is there a statistically significant difference between the MMS scores of the EG taught with the concept cartoons-supported 5E model and that of the CG taught according to the current curriculum (MoNE, 2018)?

3.Is there a statistically significant difference between the MAT and MMS scores of EG taught with the concept cartoons-supported 5E model?

4.Is there a statistically significant difference between the MAT and MMS scores of CG, taught according to the current curriculum (MoNE, 2018),

5.Is there a significant relationship between EG's and CG's MAT and MMS scores?

METHOD

Research Design

This study used a pretest-posttest quasi-experimental model with a CG. In this model, measurements are made before and after the application (Büyüköztürk et al., 2013). This method was chosen because the study examined the effect of lesson plans and activities prepared according to the concept cartoons-supported 5E model on students' mathematics performance and motivation. The study included experimental and control groups, intra-group (experimental-control), and in-group (pretest-posttest) measurements. The groups' mathematics performance and motivation were measured twice, before and after the application, using the same tools. The independent variable was implementing the concept cartoons-supported 5E model, and the dependent variable was students' mathematics performance and motivation. The study design is displayed in Table 1.

Table 1. Study Design

		Pre-Test			Post-Test	
	N	Mathematics Performance	Mathematics Motivation Scale	Operation	Mathematics Performance	Mathematics Motivation Scale
EG	16			Teaching with Concept Cartoons-supported 5E Learning Model		
CG	18			Teaching according to the Current Curriculum		

Study Group

The study was conducted with 7th-grade students at a public secondary school located in the Western Black Sea region, with similar socio-economic levels, in the academic year 2021-2022. EG and CG were randomly selected from two equivalent 7th-grade classes. 16 students (7 girls, 9 boys) in EG and 18 students (10 girls, 8 boys) in CG participated in the study. Both groups were instructed within the gains framework in the 7th-grade mathematics course, the "ratio/proportion" sub-learning area of the "numbers and operations" learning area. In EG, lesson plans and activities were prepared according to the concept cartoons-supported 5E model. In CG, only the activities of the mathematics curriculum (MoNE, 2018) were taught, and no other application took place. The analysis of EG and CG students' mathematics performance and motivation pre-test scores showed that the two groups were initially equivalent in mathematics performance and motivation.

Data Collection Tools

The Mathematics Achievement Test and the Mathematics Motivation Scale were used as data collection tools.

Mathematics Achievement Test (MAT)

In this study, 20-question MAT developed by Özkan (2019), with tested validity and reliability, was used to measure students' mathematics performance. This test was prepared to measure 7th-grade students' mathematics performance in ratio/proportion, and the reliability coefficient was 0.82. It was administered twice to both groups, once before and once after the application. MAT is given in Appendix 1.

Mathematics Motivation Scale (MMS)

MMS was developed by Üzel et al. (2018) for secondary school students; its Cronbach's alpha reliability coefficient was 0.88. It was used in this study to measure the mathematics motivation of the students. The scale consists of 26 items, 8 negative and 18 positives. The highest and lowest scores that can be obtained are 98 and 58, respectively. Higher scores mean higher student motivation toward the mathematics course. The scale was administered twice to the groups, before and after the application. MMS is given in Appendix 2.

Lesson Plans and Activities Prepared According to Concept Cartoons-supported 5E Learning Model

After getting expert opinions, the researchers developed lesson plans and activities related to ratio/proportion. The gains of the 7th-grade ratio/proportion topic in the mathematics curriculum (MoNE, 2018) and the names of the concept cartoons used in EG are given in Table 2. The lesson plans and activities used in EG were prepared within the scope of these gains.

Table 2. Name of the Concept Cartoons Used in EG and Related Gains

Concept Cartoon/Activity	Learning Outcome
Grocery Shopping	Determines the value of one of the multiplicities in the ratio if the other is 1.
The Mona Lisa painting	If the ratio of one of two given multiplicities is given, finds the other.
Oven	Analyses real-life situations and decides whether two multiplicities are proportional.
Aquarium-Fish	Expresses the relationship between two directly proportional multiplicities.
Tea Glass	Determines and interprets the ratio between two multiplicities that are directly proportional to each other.
Cargo Vehicle Wheel Size and Rotation Rate	Analyzes real-life situations and decides whether two multiplicities are inversely proportional.
Lemonade Recipes	Solves direct and inverse proportion problems.

The 5E learning model consists of five stages: Engage, Explore, Explain, Elaborate, and Evaluate. As per the name, engagement is about getting students interested in the lesson. In the exploration stage, students make predictions and test them. At this stage, the teacher acts as a guide. He/she asks questions and provides clues to help students identify incorrect or incomplete answers. Students are allowed to generate answers by using blank answer bubbles above the characters in the cartoon. Then, a discussion environment is established by allowing them to compare their answers with the answers of the characters in the cartoon. The Explanation stage is where the teacher gives explanations and information about the subject after getting students' own explanations. In the Elaboration stage, students apply their learnings to new events and problems. At this stage, it is critical to create a discussion environment, share ideas, and expect students to advocate their ideas. Finally, in the Evaluation stage, the teacher makes an assessment based on students' answers and his/her observations. One of the lessons plans prepared using the concept cartoons-supported 5E model is given in Appendix 3 as an example. This lesson plan was prepared according to the learning outcome of the ratio/proportion topic: "If the ratio of one of two given multiplicities is given, find the other."

Experimental Study Process

In the study, including EG and CG, one of the researchers taught EG, and the current mathematics teacher taught CG. The same teacher has taught mathematics to EG and CG for a long time. This feature was critical, ensuring that the study results were not biased. As the study started, one of the researchers taught EG. In contrast, CG was taught by the usual mathematics teacher. MAT and MMS were administered twice as s to both groups and completed in 4 classroom hours. Apart from the tests, both groups were taught for 18 course hours. The concept cartoons-supported 5E model was instructed to EG, and the current curriculum was taught to CG. The current mathematics curriculum (MoNE, 2018) recommends using teaching methods and techniques based on the constructivist approach, such as the explanatory lecture method (Ausubel, 2000; Ausubel & Robinson, 1969), mathematical activities, and problem-solving; thus, CG was taught accordingly. The researcher attended CG's

lessons as an observer. The activities prepared using concept cartoons according to the 5E learning model were projected using a Smart Board in the classroom. Cartoons' print-outs were distributed to students. A total of 35 concept cartoons were prepared to use at each stage of the model. Researchers generated concept cartoons on the Canva program, a free educational program used by teachers and students worldwide (https://www.canva.com/tr_tr/). They prepared concept cartoons using cartoon templates consistent with their objectives. During the preparation of the cartoons, attention was paid to possible copyright infringements and the features a concept cartoon should have. The prepared concept cartoons were presented to the experts, errors such as spelling mistakes and insufficient font size were corrected, and the cartoons were finalized. Photos from the implementation in EG are shown in Figure 1.

Figure 1. *Photos from the Implementation in EG*

Data Analysis

Analysis of Data Obtained from MAT and MMS

The data obtained from MAT and MMS administered to EG and CG before and after the implementation were analyzed using quantitative methods, using SPSS 22.00. Nonparametric methods should be employed in small samples to analyze the data instead of parametric methods. The sample size of this study was insufficient for parametric analysis (n<30); nonparametric tests - Mann-Whitney U-test and Wilcoxon Signed Ranks Test - were used without checking normal distribution. (Büyüköztürk, 2011, 2019).

Correlation analysis was conducted to describe the relationship between MAT and MMS. Since the normality assumption was not satisfied due to the low number of students, Spearman-Brown Rank Difference

correlation analysis was employed (Büyüköztürk, 2019). Here, a correlation coefficient between 0.00 and 0.25 indicates a very weak relationship between variables, 0.26 and 0.49 indicates a weak relationship and a correlation coefficient between 0.50 and 0.69 indicates a moderate relationship (Kalaycı, 2010).

Research Ethics

This research has ethics committee permission, which was obtained by the decision of Bartın University Social and Human Sciences Ethics Committee with protocol number 2022-SBB-0278, dated 14.06.2022 and numbered E-23688910-050.01.04-2200055837.

FINDINGS

Descriptive Statistics

The descriptive statistics of this study are shown on Table 3.

Table 3. Descriptive Statistics of EG and CG

Groups	Test	$\bar{X}$	sd	Shapiro-Wilk (p)
CG (N=18)	MAT Pre-Test	7.28	2.421	.314
	MAT Post-Test	14.89	2.587	.067
	MMS Pre-Test	82.11	4.825	.846
	MMS Post-Test	86.06	7.432	.814
EG (N=16)	MAT Pre-Test	6.81	1.328	.211
	MAT Post-Test	15.19	1.797	.245
	MMS Pre-Test	78.56	10.482	.087
	MMS Post-Test	84.50	5.099	.306

Table 3 shows that EG's mean MAT post-test scores ($\bar{X}$ =15,19) were higher than pre-test scores ($\bar{X}$ =6,81), and CG's mean post-test scores of ($\bar{X}$ =14,89) were higher than pre-test scores ($\bar{X}$ =7,28). Similarly, EG's mean MMS post-test scores ($\bar{X}$ =84,50) were higher than pre-test scores ($\bar{X}$ =78,56), and CG's mean MMS post-test scores ($\bar{X}$ =86,06) were higher than pre-test scores ($\bar{X}$ =82,11).

Findings Related to the Mathematics Performance Sub-problems of the Study and Interpretation

The first sub-problem of the study, "Is there a statistically significant difference between the MAT scores of EG taught with the concept cartoons-supported 5E model and that of CG taught according to the current curriculum (MoNE, 2018)?" was addressed by comparing EG's and CG's MAT pre-and post-test scores.

MAT Pre-Test Scores of EG and CG

The results of the Mann-Whitney U-test for the difference between EG's and CG's MAT pre-test scores are shown in Table 4.

Table 4. Mann-Whitney U-Test Results for EG's and CG's MAT Pre-test Scores

Group	N	Mean Rank	Sum of Ranks	U	p
EG	16	16.19	259.00	123.00	.461
CG	18	18.67	336.00		

Table 4 shows no significant difference between EG's and CG's pre-test scores (U= 123.00, p>.05), indicating that CG and EG were equivalent in mathematics performance before the implementation.

MAT Post-Test Scores of EG and CG

The results of the Mann-Whitney U-test for the difference between EG's and CG's MAT post-test scores are shown in Table 5.

Table 5. Mann-Whitney U-Test Results for EG's and CG's MAT Post-test Scores

Group	N	Mean Rank	Sum of Ranks	U	p
EG	16	17.34	277.50	141.500	.930
CG	18	17.64	317.50		

According to Table 5, at the end of the 4-week experimental study, there was no significant difference between EG and CG students' mathematics performance (U=141.500, p>.05). Regarding mean ranks, CG students' mathematics performance is higher than that of EG students. Accordingly, implementing the concept cartoons-supported 5E model did not cause a significantly higher increase in EG students' mathematics performance. Tables 4 and 5 together show that using the concept cartoons-supported 5E model and the explanatory lecture method did not create a significant difference between EG and CG in mathematics performance.

Wilcoxon Signed Rank Test Results of EG and CG's MAT Pre-and Post-test Scores

EG's MAT scores were compared using the Wilcoxon signed rank test for the first sub-problem of the study, "Is there a statistically significant difference between the MAT scores of the EG taught with the concept cartoons-supported 5E model and that of CG taught according to the current curriculum (MoNE, 2018)?" The results are given in Table 6.

Table 6. Wilcoxon Signed Rank Test Results for EG's MAT Scores

Pre-Test-Post Test	N	Mean Rank	Sum of Ranks	z	p
Negative rank	0	.00	.00	3.526*	.000
Positive rank	16	8.50	136.00		
Equal	0				

*: Based on negative ranks

According to Table 6, the difference between EG's scores obtained before and after the experimental process was significant (z=3.526, p<.05) and is in favor of the post-test. Accordingly, the implementation of the concept cartoons-supported 5E model significantly improved EG students' mathematics performance.

CG's MAT scores were compared using the Wilcoxon signed rank test for the first sub-problem of the study, "Is there a statistically significant difference between the MAT scores of EG taught with the concept cartoons-supported 5E model and that of CG taught according to the current curriculum (MoNE, 2018)?" The results are shown in Table 7.

Table 7. Wilcoxon Signed Rank Test Results for CG's MAT Scores

Pre-Test/Post-Test	N	Mean Rank	Sum of Ranks	z	p
Negative rank	0	.00	.00	3.628*	.000
Positive rank	17	9.00	153.00		
Equal	1				

*: Based on negative ranks

According to Table 7, the difference between CG's scores obtained before and after the teaching process is significant (z=3.628, p<.05) and is in favor of the post-test. The mathematics performance of CG students, to whom the concept cartoons-supported 5E learning model was not applied, and only the explanatory lecture method was applied within the scope of the activities recommended by the current mathematics curriculum, also increased. Tables 6 and 7 together show that the methods applied in both groups created a significant difference in increasing mathematics performance.

Findings of the Mathematics Motivation Sub-problems and Interpretation

To address "Is there a statistically significant difference between the MMS scores of the EG taught with the concept cartoons-supported 5E model and that of the CG taught according to the current curriculum (MoNE, 2018)?" EG's and CG's MMS pre-and post-test scores were compared.

MMS Pre-Test Scores of EG and CG

The results of the Mann-Whitney U-test for the difference between EG's and CG's MMS pre-test scores are given in Table 8.

Table 8. Mann-Whitney U-Test Results for EG's and CG's MMS Pre-test Scores

Group	N	Mean Rank	Sum of Ranks	U	p
EG	16	16.31	261.00	125.00	.511
CG	18	18.56	334.00		

Table 8 shows no significant difference between EG's and CG's pre-test scores (U= 125.00, p>.05), indicating that CG and EG were equivalent in mathematics motivation before the implementation.

MMS Post-Test Scores of EG and CG

The results of the Mann-Whitney U-test for the difference between EG's and CG's MAT post-test scores are shown in Table 9.

Table 9. Mann-Whitney U-Test Results for EG's and CG's MMS Post-test Sores

Group	N	Mean Rank	Sum of Ranks	U	p
EG	16	16.13	258.00	122.00	.447
CG	18	18.72	337.00		

Mann-Whitney U-test results of MMS post-test scores of the EG students taught using the concept cartoons-supported 5E model and the CG students taught using the explanatory lecture method within the activities of the current curriculum are shown on Table 9. Accordingly, at the end of the 4-week experimental study, MMS scores of EG and CG students did not differ significantly (U=122.00, p>.05).

Regarding mean ranks, CG students' mathematics motivation is higher than EG students'. According to this result, it can be said that implementing the concept cartoons-supported 5E model did not significantly increase EG students' mathematics motivation. Tables 8 and 9 together show that the concept cartoons-supported 5E model and explanatory lecture method did not create a significant difference between EG and CG in mathematics motivation scores.

Wilcoxon Signed Rank Test Results of EG and CG's MMS Pre-and post-test Scores.

To address "Is there a statistically significant difference between the MMS scores of the EG taught with the concept cartoons-supported 5E model and that of the CG taught according to the current curriculum (MoNE, 2018)?" EG's MMS pre-and post-test scores were compared using the Wilcoxon signed-rank test, and the results are given in Table 10.

Table 10. Wilcoxon Signed Rank Test Results for EG's MMS Scores

Pre-Test/Post-Test	N	Mean Rank	Sum of Ranks	z	p
Negative rank	1	9.50	9.50	3.032*	.002
Positive rank	15	8.43	126.50		
Equal	0				

*: Based on negative ranks

Table 10 shows a significant difference between EG's scores obtained before and after the experimental process (z=3.032, p<.05) in favor of the post-test. Accordingly, the implementation of the concept cartoons-supported 5E model had a significant effect on increasing EG students' mathematics motivation.

Regarding the second sub-problem of the study, "Is there a statistically significant difference between the MMS scores of EG taught with the concept cartoons-supported 5E model and that of CG taught according to the current curriculum (MoNE, 2018)?" CG's MMS pre-and post-test scores were compared using the Wilcoxon signed-rank test, and the results are shown in Table 11.

Table 11. Wilcoxon Signed Rank Test Results for CG's MMS Scores

Pre-Test/Post-Test	N	Mean Rank	Sum of Ranks	z	p
Negative rank	2	16.25	32.50	2.319*	.020
Positive rank	16	8.66	138.50		
Equal	0				

*: Based on negative ranks

Table 11 shows a significant difference between CG's scores before and after the implementation (z=2.319, p<.05) in favor of the post-test. The mathematics motivation of CG students, to whom the concept cartoons-supported 5E learning model was not applied, and only the explanatory lecture method was applied within the scope of the activities recommended by the current mathematics curriculum, also increased. Tables 10 and 11 together show that the methods applied in both groups significantly increased mathematics motivation.

Results of the Correlation Analysis Between EG's and CG's MMS and MAT Scores

The sub-problem "Is there a significant relationship between EG's and CG's MAT and MMS scores?" was addressed. The results of the correlation analysis between MMS and MAT scores are given in Table 12.

Table 12. Results of the Correlation Analysis Between EG's and CG's MMS and MAT Scores

Group	Variables	Spearman-Brown (r)	MAT	MMS
EG	MAT	r	1	.447
		p	.0	.083
		N	16	16
	MMS	r	.447	1
		p	.083	.0
		N	16	16
CG	MAT	Correlation Coefficient	1	.307
		p	.0	.215
		N	18	18
	MMS	r	.307	1
		p	.215	.0
		N	18	18

r: Correlation Coefficient

The Spearman-Brown rank difference analysis was conducted to test whether there is a statistically significant difference between the MAT and MMS post-test scores of EG and CG students [rd (16) = 0.447, $p \geq 0.05$; rk (18) = -0.307, $p \geq 0.05$]. Table 12 shows that EG and CG students' MAT and MMS post-test scores did not differ significantly.

DISCUSSION & CONCLUSION

This study investigated the effect of the concept cartoons-supported 5E model on secondary school students' mathematics performance and motivation. The analysis showed that after a 4-week experimental study, MAT scores of EG students taught with the concept cartoons-supported 5E model and MAT scores of CG students to whom this method was not used did not differ significantly. From this finding, it can be concluded that the concept cartoons-supported 5E model did not increase mathematics performance more than the explanatory lecture method used within the mathematics curriculum framework. In other words, the concept cartoons-supported 5E model and the explanatory lecture method did not create a significant difference in EG and CG regarding mathematics performance. However, the within-group analysis showed a significant difference between the scores of EG and CG in favor of the post-test. Accordingly, both the concept cartoons-supported 5E model applied to EG and the explanatory lecture method applied to CG significantly improved students' mathematics performance.

In this study, the concept cartoons-supported 5E learning model applied in the mathematics course was expected to positively affect mathematics course performance and mathematics motivation of 7th-grade secondary school students more than the explanatory lecture method. However, the post-test scores of the groups did not differ significantly, concluding that both methods effectively increase mathematics performance when used effectively. Regarding the relevant literature, some studies in natural science contradict this study (Atasoy et al., 2020; Aydın, 2015; Çelik & Gündoğdu, 2016; Çil, 2014; Gomez, 2014; Meriç, 2014; Özmen et al.). Regarding the field of mathematics education, the findings of some studies involving concept cartoons-supported teaching are not similar to the mathematics performance findings of this study. Marques et al. (2023) found that concept cartoons were effective in teaching new concepts; Pekel (2021) reported that concept cartoons, especially discussion-based concept cartoons, improved students' mathematics performance, and Aygün et al. (2020) found that they were effective in improving students' understanding of mathematics symbols, terms, and concepts. Similarly, Batdal Karaduman and Elgün Ceviz (218), Dereli (2008), Erdağ (2011), Katipoğlu (2016), Kaplan and Öztürk (2015), Samkova (2018), Önal and Çilingir Altiner (20-22), and Yağıcı (2019) reported that concept cartoon-supported teaching improved students' mathematics performance. The results of these studies are not parallel with this study regarding mathematics performance. Furthermore, Yılmaz (2018) found that EG students' mathematics performance, in which the concept cartoons-supported 5E model was used to teach mathematics, was significantly higher than CG students' mathematics performance taught according to the current curriculum. In

this respect, this study's results contradict our study's results. On the other hand, the studies showing that concept cartoons-supported teaching was not effective in eliminating misconceptions (Gökkurt Özdemir et al., 20-21) and improving mathematics performance (Güler, 2010; Korucu, 2009) support the results of this study.

The study's second sub-problem examines the effect of the concept cartoons-supported 5E model on students' mathematics motivation. The method used to teach EG was expected to be more effective in increasing mathematics motivation than the method used in CG. However, the analysis results did not support this. The independent samples' analyses showed that the scores of EG and CG did not differ significantly. Similarly, the analysis of the dependent sample showed no significant difference between the pre-and post-test MMS scores of EG and CG. Based on these findings, it can be concluded that the concept cartoons-supported 5E model was not more effective in increasing students' mathematics motivation in the EG. This finding is supported by a study conducted by Atasayar Yamık (2015), which showed that concept cartoons were ineffective in increasing students' motivation toward learning science. Meriç (2014) reported that concept cartoons-supported teaching did not significantly affect secondary school students' motivation scores toward participation. However, it positively contributed to their motivation toward performance. Based on her observations, Yürekli (2020) found that concept cartoons improved students' motivation and positively affected their interest in mathematics. The mathematics motivation results of Yürekli's (2020) study and this study contradicts.

The results of this study showed that EG's and CG's scores did not differ significantly. Conducting in-depth studies using qualitative methods to investigate the reasons may be advisable. Similarly, Güler (2010) concluded that using concept cartoons in the lessons did not make a significant difference in the groups' mathematics performance increase. However, the study's qualitative findings showed that most secondary school students were content with the lessons supported by concept cartoons. In the same study, a small group of students complained about the noise during the lesson and that they could not concentrate, stating that their interest in the lesson decreased because they were not used to the lesson being taught using concept cartoons.

This study also examined whether there is a relationship between MAT and MMS and its level, if any. The correlation analysis between MAT and MMS scores showed no relationship between EG and CG scores on both tests. Dede and Argün (2004) investigated the relationship between intrinsic and extrinsic motivation in mathematics courses. They found that factors that increase extrinsic motivation do not affect intrinsic motivation. In the study by Usta and Çağan (2020), the correlation analysis showed no significant relationship between performance and motivation. The results of Dede and Argün (2004) and Usta and Çağan (2020) are consistent with the results of this study regarding the lack of a significant relationship between mathematics performance and motivation. On the other hand, in their study with 5th-grade students, Bozkurt and Bircan (2015) reported a significant relationship between mathematics performance and motivation and that intrinsic and extrinsic motivation positively affect academic performance. Similarly, Middleton and Spanias (1999) showed that secondary school students' mathematics performance perceptions affect their motivational attitudes. Herges et al. (2017) showed a strong positive relationship between intrinsic motivation and performance, while extrinsic motivation has a moderate effect. The results of Bozkurt and Bircan (2015), Herges et al. (2017), and Middleton and Spanias (1999) are not parallel with the results of this study.

Several suggestions can be made based on this study's results. Some studies show that motivation has a significant effect on mathematics achievement. Our study concluded that the concept cartoons-supported 5E model did not increase secondary school students' mathematics performance and motivation more than conventional teaching. On the other hand, the analysis of related samples showed that the effective use of both methods in EG and CG increased mathematics performance. It is known that there are many reasons affecting performance and motivation. Thus, an in-depth study of the factors affecting mathematics performance and motivation with qualitative methods is recommended as a follow-up to this study. The concept of motivation can also be investigated in detail with its components. This study was conducted with 7th-grade students on ratio/proportion topics. It is recommended to conduct comparative and mixed studies at different grade levels and on different subjects. This study was conducted with a small study group. It is recommended to conduct this study on a larger sample. Readers are advised to evaluate study results in line with these suggestions.

Statements of Publication Ethics

The authors of this article declare that this research has not any ethical conflicts or problems that may limit the publication of the article.

Researchers' Contribution Rate

First author's contribution 40% , Other authors contribution 15%

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Author 1's name	☒	☒	☒	☒	☒	☒
Author2's name	☒	☐	☒	☐	☐	☐
Author 3's name	☒	☐	☒	☐	☐	☐
Author 4's name	☐	☐	☒	☒	☐	☐
Author 5's name	☐	☐	☒	☒	☐	☐

Conflict of Interest

The authors have no conflicts of interest to disclose.

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APPENDIX

Appendix 1.

Mathematics Achievement Test (MAT)

Q.1) The ratio of Ayşe's age to Zehra's age is $\frac{3}{5}$, and the ratio of Zeynep's age to Ayşe's age is $\frac{5}{6}$. Zeynep is 15 years old; how old is Zehra?
A) 15 B) 20 C) 25 D)30

Q.2) The ratio of the number of male students to the number of female students in a theatre club is $\frac{5}{6}$. Since there are 10 male students in this theatre group, how many female students are there?
A) 11 B) 12 C) 13 D) 14

Q.3) The price of 30 pencils is 7.5 TL. How many kurush is one pencil?
A) 15 B)25 C)30 D)50

Q.4) The larger of two numbers with ratios of $\frac{3}{4}$ is 48; what is the difference between these two numbers?
A) 8 B) 10 C) 12 D) 16

Q.5) A store offers a $\frac{1}{2}$ discount on the second product if 2 of the same product are bought. How much will someone who buys 2 belts with a price of 40 TL pay for these belts?
A) 50 B) 60 C) 70 D) 80

Q.6) A landscape picture is printed as a rectangle with a length of 12 cm and a width of 10 cm. When this picture's length is enlarged to 18 cm, how many cm should its width be so the width/length ratio does not change?
A) 12 B) 13 C) 14 D) 15

Q.7) Which of the following equations expresses the relationship between the two multiplicities on the table?
A) y=4x B) x=4y C) x=4 D) y=4

x	y
2	8
3	12
4	16
5	20
6	24

Q.8)

Two connected gears move together.
The large wheel has 30 teeth, and the small wheel has 12 teeth. Which of the following is incorrect?

A) If the small wheel makes 10 revolutions, the large wheel makes 4 revolutions.
B) If the big wheel makes 2 revolutions, the small wheel will make 5 revolutions.
C) If the big wheel makes 2 revolutions, the small wheel will make 1 revolution
D) If the small wheel makes 6 revolutions, the big wheel makes 3 revolutions.

Q.9) Fatih goes to the market to buy eggs and reads the information note that says "5 eggs for 7 TL". He bought 1 egg after learning that he could buy them in pieces. How much change should Fatih get from the seller if he gave 2 TL to the seller?
A) 0,6 B) 0,8 C) 1,4 D) 1,6

Q.10) If 1250 grams of pistachio is 20 TL, how much does a kilo of pistachios cost?
A) 16 B) 15 C) 13 D) 12

Q.11) At a scout camp with 15 students, there is enough food to last them for 12 days. At the end of the 4^{th} day, 5 more students arrive at this scout camp; how many days will the remaining food last for all the students?
A) 7 B) 6 C) 5 D) 4

Q.12)

Model / Specs	X	Y	Z
Price (TL)	500	600	750
Length (cm)	20	24	30
Weight (gram)	100	110	160
Warranty (Year)	2	3	4

The table to the left shows the specifications of different models X, Y, Z of a tablet. According to this, which of the following specifications are directly proportional to each other?

A) Price - Length
B) Price - Weight
C) Length- Weight

Q.13) The price of a mobile phone is discounted from 360 TL to 280 TL. If the discount rate on the mobile phone is also applied to an MP3 player with an original price of 72 TL, what should be the price of the MP3 player?
A) 48 B) 54 C) 56 D)60

Q.14) $\frac{X}{6} = \frac{Y}{8}$
If the constant is 5 in the ratio given above, what is x + y?
A) 50 B) 60 C) 70 D) 80

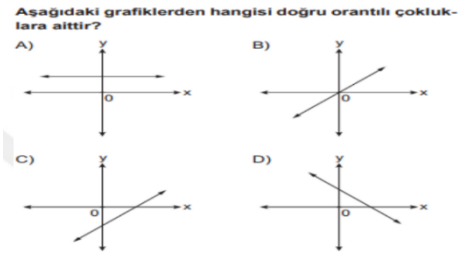
Q.15)

x	y
2	6
3	9
4	12
5	15
6	18

The table showing the relationship between two directly proportional multiplicities is shown in the figure. Which of the options below is the ratio constant for these two multiplicities?

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{1}{4}$ D) $\frac{1}{6}$

Q.16)



Which of the graph below belongs to directly proportional multiplicities?

Q. 17)

A	1	2	4	5	y
B	120	x	30	24	15

In the table above, the numbers A and B are inversely proportional. Find the values of x and y accordingly.
A) x= 60, y=12 B) x= 50, y= 7 C) x= 60, y= 8 D) x=40, y=6

Q.18) A worker works at a certain speed and completes a job in 20 days. How many days would it take this worker to complete the same job if he doubled his speed?
A) 5 B) 10 C) 20 D) 40

Q.19) A bakery makes identical lemonade in different quantities daily. Which of the following tables shows a direct relationship between the amount of lemonade and water?

A)

Water (Litre)	5	10	15	20
Lemonade (Litre)	9	12	15	20

B)

Water (Litre)	5	10	15	20
Lemonade (Litre)	30	30	30	30

C)

Water (Litre)	5	10	15	20
Lemonade (Litre)	9	18	27	36

D)

Water (Litre)	5	10	15	20
Lemonade (Litre)	10	15	20	25

Q.20) "If 1 kg of apples costs 6 TL, how many TL are 4 kg of apples?" Which of the following ratios can be used to solve the problem?
A) $\frac{4}{1} = \frac{6}{X}$ B) $\frac{1}{4} = \frac{x}{6}$ C) $\frac{4}{1} = \frac{x}{6}$ D) $\frac{6}{4} = \frac{x}{1}$

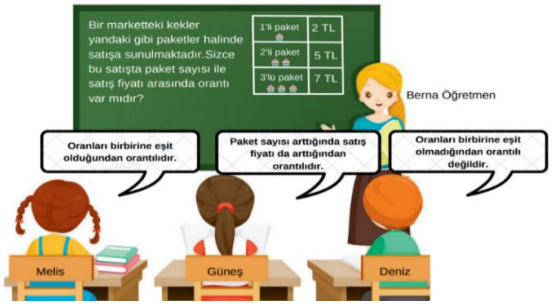
Appendix 2.

Motivation Scale for Mathematics Course

İfadeler	Hiç Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Tamamen Katılıyorum
1.Matematik dersinde bana öğretilenler dışında bir şey öğrenmeye çalışmam.					
2.Matematik dersindeki zor soruları cevaplamaktan zevk alırım.					
3.Sınıfta öğrendiğimden daha fazlasını öğrenmek için çalışırım.					
4.Matematik dersine çalışmaktan zevk alırım.					
5.Sınav olmadığı zamanlarda bile matematik dersini tekrar ederim.					
6.Matematik dersinden önce notlarımı tekrar ederim.					
7.Matematikten düşük not almak beni mutsuz yapar.					
8.Matematik dersini anlamayı denerim.					
9.Matematik dersinden en yüksek notu almak isterim.					
10.Okulda başarılı olduğum zaman kendimi iyi hissederim.					
11.Matematik dersinde başarılı olmayı severim.					
12.Matematik derslerine ilgi duymam.					
13.Matematik dersinde öğrendiklerimizin, yaşantımızı kolaylaştıracağına inanıyorum.					
14.Matematik dersinde zamanımı boşa harcadığıma inanıyorum.					
15.Matematik dersi gerçek yaşamdaki bilgiler ile bağlantılıdır.					
16.Ders kitapları dışında matematik kitapları okumam.					
17.Matematik dersi benim için bir yüktür.					
18.Matematik dersinde konuyla ilgili tartışmalara katılmayı sevmem.					
19. Matematik ile ilgili televizyonda çıkan yayınları izlemeye çalışırım.					
20.Matematik dersleri beni ürkütür.					
21.Matematik dersinde merak ettiğim bilgileri araştırır, öğrenirim.					
22.Matematik dersine çalışmak beni dinlendirir.					
23.Matematik dersiyle ilgili yapılan uygulamaları vakit kaybı olarak görürüm.					
24.Matematik dersi sevilmese bile öğrenilmesi gereken bir derstir.					
25.Matematikteki yeni fikirleri öğrenmek isterim.					
26.Matematik dersinde çözdüğümüz soruları ilk bitiren kişi olmak isterim.					

Appendix 3.

A Sample Lesson Plan Prepared with Concept Cartoons-Supported 5E Model

Course Name	Mathematics
Grade Level	7th grade
Time	3-course hours
Teaching Methods and Techniques	Concept Cartoons-supported 5E Model, question and answer, discussion
Materials	Blackboard, projector, computer
Topic	Numbers and Operations
Sub-Topic	Ratio/proportion
Gain	When one of two multiplicities whose ratio is known is given, finds the other.
Enter	Uses ratios in comparing multiplicities and shows ratios in different forms. If a whole is divided into two parts, finds the ratio of the two parts to each other or of each part to the whole, and finds the other when one of them and their ratios are given. Finds the ratio of two quantities in the same or different units.
Engage	
Explore	 Which of the answer(s) given by the students seeking answers to the question do you agree with? Please explain why.
Explain	In the exploration stage, students express their ideas and share their conclusions with their friends. The teacher then explains how to find the value of one of the two multiplicities, whose ratio is known, when the other is given, as shown below. *Information Box* To find one of the multiplicities, whose ratio is known, when the value of the other is given, the ratio is expanded by an appropriate number to find the multiplicity that is not given. The result is obtained by increasing or decreasing the ratio according to the number of multiplicities After this explanation, the following activity will be carried out with the students: *Activity*. This activity aims to intuit how to find one of the two multiplicities given the ratio of one to the other. 

Problem Situatio. Sinem, who plans to sell lemonade in her bakery, wants to make lemonade by mixing water, sugar, and lemon at two different ratios.

For this purpose, Ms. Sinem decided to prepare lemonades with two different recipes. She created the table below showing the amount of lemonade and the amounts of ingredients used.

Table 1. number of ingredients to be used according to the number of customers

Lemonade Recipes	Customers	Water	Sugar	Lemon
First Recipe	8	2 L	1 kg	4 pcs
Second Recipe	12	4 L	2 kg	6 pcs

Given this information, Sinem started making lemonade for tomorrow. Use the table to answer the following questions.

First, find out how many lemons will be needed for a birthday party for 24 people if the first recipe is preferred.

$$\frac{Number\ of\ people}{Amount\ of\ Lemon} = \frac{8}{4} = \frac{8\,.3}{4\,.3} = \frac{24}{12}$$

The answer is 12 if you write the ratio in the formula above. Answer the other questions accordingly.

a) How many liters of water are needed if the first recipe is preferred for a birthday party of 16 people?

b) How many kilograms of sugar are needed if the second recipe is preferred for a party of 36 people?

c) How many lemons will be needed if the second recipe is preferred for a party of 24 people?

Elaborate

Which of the answer(s) given by the students seeking answers to the question do you agree with? Please explain why.

Evaluate

Ozan wants to create a family tree in which the ages of the family members can be determined by a ratio.

He gives the following information about the ages of his family members.

My mother is 35 years old.

The ratio of my mother's age to my father's age is 7/8.

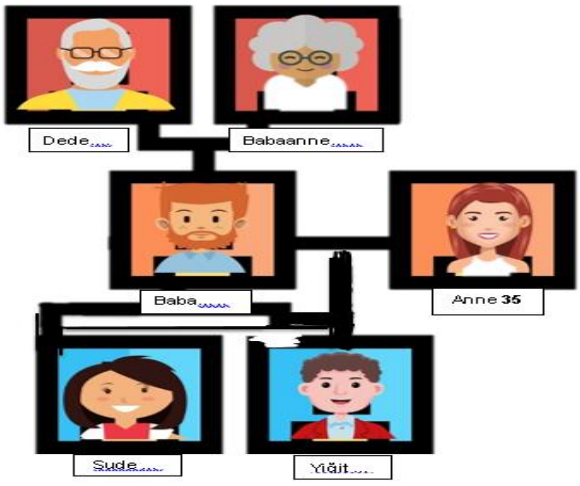
The ratio of my sister Ezgi's age to my father's age is 1/4.

The ratio of Ezgi's age to my age is 5/6.

The ratio of my age to my grandmother's age is 1/5.

The ratio of my grandmother's age to my grandfather's age is 12/13.

Help Ozan complete the family diagram by finding the ages of his family members.



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Development of the Early Childhood Self-Compassion Scale Parent Form (ECSCS-P)*

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Abstract

Today, individual well-being studies point to childhood experiences and focus on self-regulation, self-awareness, compassion, and self-compassion. This study aims to develop a measurement tool to determine self-compassion in early childhood. The study was designed using the survey model, one of the quantitative research methods. The study group consisted of 509 parents of 48-72-month-old children attending official kindergartens and preschools in the central districts of Ankara, selected by random sampling method. The 64-item item pool developed for the measurement tool was reduced to 47 items with expert opinions. As a result of the pilot study with five parents, the statements were edited, and the scale was finalized. The 47-item form was administered to 309 parents, and 27 items were removed from the form due to exploratory factor analysis. The factor loadings of the remaining items ranged between .48 and .84, forming a 4-factor structure. The new form was reapplied to 200 parents, and confirmatory factor analysis was conducted with the data. As a result of the study, it was seen that the item factor loadings were between 0.435 and 0.833, x^2 / sd (2.05) was below 5, RMSEA (0.07) was below 0.08, CFI (0.90) and TLI (0.89) were acceptable, and the 4-factor structure was confirmed. The factors Cronbach Alpha coefficients were calculated as 0.745, 0.731, 0.742, 0.784, respectively. Pearson coefficients for the test-retest application were calculated as r=0.75, r=0.52, r=0.53 and r=0.51, respectively. Based on the data, the Early Childhood Self-Compassion Scale Parent Form (ECSCS-P), comprising 20 items under four factors, has a valid and reliable structure.

Keywords: self-compassion, early childhood, preschool, parent, scale

Erken Çocukluk Dönemi Öz Şefkat Ölçeği Ebeveyn Formu'nun (EÇÖŞ-E) Geliştirilmesi

Öz

Günümüzde bireysel refah ve iyi oluş çalışmaları çocukluk deneyimlerini işaret etmekte ve öz düzenleme, öz farkındalık, şefkat ve öz şefkat gibi kavramlara odaklanmaktadır. Bu çalışmanın amacı erken çocuklukta öz şefkat düzeyini belirlemek üzere bir ölçme aracı geliştirmektir. Araştırma nicel araştırma yöntemlerinden tarama modelinde tasarlanmıştır. Ankara ili merkez ilçelerinde yer alan resmi anaokulları ve anasınıflarına devam eden 48-72 aylık çocuklardan tesadüfi örnekleme yöntemiyle seçilen 509 çocuğun ebeveyni çalışma grubunu oluşturmaktadır. Ölçme aracı için geliştirilen 64 maddelik madde havuzu uzman görüşleri ile 47 maddeye düşürülmüştür. 5 ebeveyn ile yapılan pilot uygulama sonucunda ifadeler düzenlenerek ölçek son halini almıştır. 47 maddelik form 309 ebeveyne uygulanmış, açımlayıcı faktör analizi sonucunda 27 madde formdan çıkarılmıştır. Kalan maddelere ait faktör yükleri ,48 ile ,84 arasında değişmekte ve bu maddeler 4 boyutlu bir yapı oluşturmaktadır. Oluşan yeni form 200 ebeveyne yeniden uygulanmış, veriler ile doğrulayıcı faktör analizi yapılmıştır. Analiz sonucunda madde faktör yüklerinin 0,435 ilâ 0,833 arasında, x^2 / sd (2,05) değerinin 5'in altında, RMSEA (0,07) değerinin 0,08'in altında, CFI (0,90) ve TLI (0,89) değerlerinin kabul edilebilir durumda olduğu ve 4 faktörlü yapının doğrulandığı görülmüştür. Alt boyutlara ait Cronbach Alpha kat sayıları sırasıyla 0,745; 0,731; 0,742; 0,784 ve test tekrar test uygulamasına ilişkin Pearson katsayıları sırasıyla r=0.75, r=0.52, r=0.53 ve r=0.51 olarak hesaplanmıştır. Verilere dayalı olarak 20 madde ve 4 alt faktörden oluşan Erken Çocukluk Dönemi Öz Şefkat Ölçeği Ebeveyn Formu'nun (EÇÖŞ-E) geçerli ve güvenilir bir yapıya sahip olduğu söylenebilir

Anahtar kelimeler: öz şefkat, erken çocukluk, okul öncesi, ebeveyn, ölçek

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INTRODUCTION

Early childhood experiences significantly affect physical and mental health (McEwen, 2008). Adverse and unexpected life events in childhood, such as loss, neglect, abuse, natural disasters, pandemics, war, and migration, put emotional strain on children, and they need resources to cope with these difficulties (Churchill et al., 2023; Lyons et al., 2023; Mokbul, 2023; Talja et al., 2022; Zheng et al., 2022). Studies to improve well-being in children focus on self-regulation, self-awareness, social-emotional learning, empathy, and compassion (Durlak et al., 2011; Greenberg et al., 2001; Greenberg et al., 2003; Seligman & Csikszentmihalyi, 2000; Zins et al., 2004). In addition to these concepts, recent studies emphasize the idea of self-compassion.

Self-compassion is defined as being a good friend to oneself and supporting oneself in difficult situations as if supporting someone else. Instead of using judgmental, critical, punitive language in one's inner conversations in the face of problems, it uses an accepting, supportive, understanding language and soothing and self-care. Self-compassion is said to emerge with the support of three components: mindfulness, common humanity, and self-kindness. Mindfulness is recognizing the events that are happening at the moment and one's feelings about them as they are, without exaggerating or suppressing them. Mindfulness is a process based on recognizing the event and the change it creates in one's emotional state and body. Common humanity includes the acceptance that all people will encounter complex events and emotions from time to time and will have to cope with pain. This component prevents the individual from feeling isolated by supporting the feeling that they share their difficult situations and emotions with others and are not alone. Being connected to the community is a supportive feature in coping with difficulties. The last component, self-kindness, is taking care of oneself in a kind way during difficult times instead of approaching oneself in a critical/hostile manner. It includes taking time to spend time with activities, places, and people that one enjoys and feels good about and supporting oneself physically, emotionally, mentally, relationally, and spiritually during difficult times (Germer & Neff, 2020; Neff, 2003a; Neff & Costigan, 2014; Neff & Tirch, 2013). Examples of self-kindness include physically engaging in acts of comfort such as watching the sky, taking a shower, sunbathing, and drinking a favorite beverage; emotionally spending time in supportive/pleasurable places (e.g., the seashore) with objects (e.g., a blanket), actions or hobbies; mentally daydreaming, repeating mantras; relationally building relationships that are understood and accepted; and spiritually turning to one's values and beliefs (Germer, 2009).

As a skill, self-compassion benefits individuals in various areas. Studies on youth have shown that self-compassion is related to well-being (Neff & McGee, 2009). In children, self-compassion was positively associated with social-emotional well-being and indicators such as self-concept, optimism, satisfaction with life, and pro-social goals (Sutton, 2014; Sutton et al., 2018). It is also stated that early self-compassion is associated with early emotion regulation, self-esteem, temperament, and internalizing behaviors (Bailey, 2020). Experimental studies with children have shown that self-compassion reduces anxiety symptoms and positively affects emotion regulation, well-being, and resilience (Barclay-Timmis, 2019; Syeda, 2019). Based on the research results, self-compassion is a personality trait that impacts emotional skills such as emotion regulation, well-being, and resilience, allowing individuals to be happier and more compatible with society.

When the literature is reviewed, it is seen that the scale developed by Neff (2003b) to measure self-compassion in adults has been translated into various languages, and a short form has been created and adapted for adolescents. The scale developed for adults was also adapted into Turkish in two separate studies (Akın et al., 2007; Deniz et al., 2008). Bailey (2020) adapted Neff's (2003a) original self-compassion scale for early childhood and obtained a scale consisting of 10 items and two subscales: positive and negative self-compassion. However, this study aimed to comprehensively develop a scale to evaluate self-compassion in early childhood. For this purpose, answers to the following questions will be sought:

1- Is the Early Childhood Self-Compassion Scale Parent Form (ECSCS-P) valid?

2-Is the Early Childhood Self-Compassion Scale Parent Form (ECSCS-P) reliable?

METHOD

Research Design

The research is a quantitative study and was conducted using the survey model. The survey model is a type of study in which the results of the research conducted on a sample selected from the universe to determine the current situation of a phenomenon are generalized to the universe. Within the scope of this research, since a measurement tool to be used to determine the level of self-compassion for early childhood is developed and the

current situation is revealed, the research is in the survey model (Büyüköztürk et al., 2020, s. 16; Christensen et al., 2020, s. 368).

Study Group

The study group consisted of 509 parents of 48-72-month-old children between the ages of 48-72 months attending official kindergartens and preschools selected by random sampling from schools in the central districts of Ankara province in the 2021-2022 academic year. To obtain a study group suitable for factor analysis, reference was made to the sources that at least five times the number of variables and 200 people are sufficient (Büyüköztürk, 2002; Kline, 1994; MacCallum et al., 1999). The exploratory factor analysis (EFA) was conducted with 309 parents, and the confirmatory factor analysis (CFA) with 200 parents. The demographic data of the participants are presented in Table 1.

Table 1. Demographic Data of Parents and Children

Variables	Categories	f
Gender of the Child	Girl	245
	Boy	264
	Total	509
Number of Siblings of the Child	Only child	154
	One sibling	274
	2 siblings	67
	3 siblings	14
	Total	509
	Primary School	34
	Secondary School	56
	High School	162
	Undergraduate	224
	Graduate	24
	Total	499
Father's Education Status	Primary School	19
	Secondary School	48
	High School	187
	Undergraduate	205
	Graduate	50
	Total	499
Mother’s Age	23-30	105
	31-35	206
	36-40	123
	41-45	44
	46-50	16
	Total	494
Father’s Age	27-35	183
	35-40	160
	41-45	104
	46-50	34
	51-55	12
	Total	493

Of the parents who participated in the study, 48.14% (n=245) had girls and 51.87% (n=264) had boys. While 30.25% (n=154) of the children were without siblings, 53.83% had one sibling (n=274), 13.16% had two siblings (n=67), and 2.75% (n=14) had three or more siblings. Although the parents' educational levels varied, most had a bachelor's degree. The mother's age ranged between 23 and 50 years, and the father was between 27 and 55. Ten mothers and ten fathers preferred not to indicate their level of education, while 15 mothers and 16 fathers preferred not to indicate their age.

Data Collection Tools

Demographic Information Form and Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P) developed by the researchers were used as tools for data collection.

1. Demographic Information Form

This form includes demographic data such as the child's age (month), gender, number of siblings, parent's age, and education level.

2. Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P)

The scale developed by the researchers within the scope of this study consists of four factors: self-kindness, self-caregiving, over-identification, and self-criticism. It includes self-compassionate behaviors and allows predictions to be obtained about children's self-compassion characteristics. It consists of five-point Likert-type items reporting frequency (Never, Rarely, Occasionally, Frequently, Always) answered by parents based on their observations of their children in the last four weeks.

Data Collection

Data were collected from parents of children attending preschool education institutions. First, the children's teachers were contacted, the purpose of the research was explained, and their support for the research was obtained. The teachers helped to deliver and collect printed participant consent forms to the parents. The parents filled out the forms and submitted them to the teacher, and the researcher received the forms from the teacher in bulk. 309 parents filled out the form for exploratory factor analysis, and 200 parents filled out the form for construct factor analysis. In addition, 25 parents were also provided data to calculate test-retest reliability.

Data Analysis

The data were entered into a statistical program by the researcher. The data was sorted and made ready for testing. KMO and Barlett's tests were run to test the suitability of the sample for the exploratory factor analysis. An exploratory factor analysis was conducted to reveal the scale's factor structure. When the scale's factor structure was finalized, confirmatory factor analysis was performed in the Mplus program, and χ^2/ sd, RMSEA, CFI, and TLI values were taken as references to test the accuracy of the determined structure. As reliability tests, Cronbach's alpha value was calculated to determine the scale's reliability, and the Pearson coefficient test was calculated for test-retest reliability.

Research Ethics

The ethical approval was obtained from the Gazi University Ethics Commission, and the Provincial Directorate of National Education provided implementation permissions. The preschools that children were attending were determined by random sampling method, the administrations of the schools were informed about the study, the approval of the ethics commission and the permission of the Provincial Directorate of National Education were presented, and their approval for the study was obtained by stating that ethical rules would be followed. No identity information was requested on the forms, and the data were collected anonymously by keeping the identities of children and parents confidential.

FINDINGS

To prove that the Early Childhood Self-Compassion Scale-Parent Form is a valid and reliable measurement tool, content validity, construct validity, Cronbach's Alpha, and Pearson coefficient for reliability were used.

Content Validity

In the process of developing the Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P), a literature review was first conducted (Atalay, 2021; Bailey, 2020; Barclay-Timmis, 2019; Germer, 2009; Germer & Neff, 2020; Gilbert, 2009; Kabat Zinn, 2021; Neff, 2003a; Neff, 2003b; Neff & Costigan, 2014; Neff et.al., 2021; Neff & McGehee, 2010; Neff & Tirch, 2013; Pepping et. al., 2015; Potter et. al., 2014; Selvili, 2021; Sutton, 2014; Sutton, et. al., 2018). Adult and adolescent scales developed by Neff (2003), various translations of the adult scale, and scales developed for children were examined. As a result of the studies, it was decided to develop a scale that includes behavior-based indicators to determine children's self-compassion levels and to be completed by an adult who knows the child well. In line with the literature review, a pool of 64 items to assess self-compassion in children was created by utilizing the three sub-factors (awareness, common humanity, self-kindness) expressed by Neff (2003b) and three sub-factors that are the opposite of these (over-identification, isolation, self-criticism),

among the five ways to support self-compassion described by Germer (2009), physical, mental, emotional and relational ways are suitable for children, and sub-factor of compassion defined by Gilbert (2009).

Table 2. Opinions Based on the Development of the Scale

	Mindfulness	Over Identification	Common Humanity	Isolation	Self Kindness	Self Judgement	Physically Pathway for Self Compassion	Mentally Pathway for Self Compassion	Emotionally Pathway for Self Compassion	Relationally Pathway for Self Compassion	Care for Wellbeing	Sensitivity	Sympathy	Distress Tolerance	Empathy	Open Non-judgemental	Atention	Reasoning	Behaviour	Imagery	Feeling	Sensory
Neff, 2003	√	√	√	√	√	√																
Germer, 2009							√	√	√	√												
Gilbert, 2009											√	√	√	√	√	√	√	√	√	√	√	√

In addition, interviews were conducted with parents to ensure content validity. As a result of the analysis of the interviews, it was determined that children need compassion in moments of physical strain, such as fatigue and illness, in time-dependent moments, such as before sleep and waking up in the morning, and when they experience emotions, such as loneliness, sadness, guilt, failure, disappointment, anxiety, anger, and fear. In these challenging moments, it was stated that children showed behaviors such as denial, avoidance, ignoring, isolation, rumination, over-identification, shouting, nail-biting, and hitting, which indicate low self-compassion, as well as behaviors that may be examples of self-compassionate behavior such as self-expression, producing solutions, asking for help from the adult, asking questions to understand the situation, and requesting explanations.

It was reported that when children needed compassion, they requested time together and verbal and tactile support from outside. In addition, parents emphasized that children engaged in behaviors such as drawing, playing games, talking to themselves and consoling themselves, turning to reassuring material, and turning to a job they are good at to offer compassion to themselves when they need compassion. Based on this information, adjustments were made to the instructions and items of the scale.

The resulting item pool was presented to the opinions of three preschool education experts, one psychological counseling expert who has studied mindfulness and compassion, and one measurement and evaluation expert. The expert opinion form was prepared so the experts could evaluate each item to measure the desired feature and language and provide their opinions and suggestions. The evaluations received from the experts were processed and analyzed on the specification table. Seventeen items were removed from the form due to the presence of similar items or because they were not suitable for the age group. In addition, wording corrections were made in some items. The 47-item form was discussed with five mothers via telephone interviews, and the form was finalized by correcting the statements that were not understood and thought to be inappropriate for the age group of the children.

Construct Validity

Principle component analysis (PCA), which is used to summarize and reduce data, was used to examine the construct validity of the data obtained from 309 people as a result of the trial form application of the scale and to reveal the components of the scale aimed to be developed. The Kaiser-Meyer-Olkin (KMO) value and Barlett's Test results, which were calculated to evaluate the suitability of the sample for the analysis, are given in Table 3.

Table 3. KMO and Barlett's Test Results

Kaiser-Meyer-Olkin (KMO)		*0,809*
Barlett's Test	χ^2	*4964,558*
	sd	*1081*
	p	*0,000*

The analysis showed that the KMO value was at the desired level (>0.60; KMO=0.809) and Barlett's Test was significant (χ^2=4964.558; p<.01; Tabachnick & Fidell, 2013), indicating that the data were suitable for analysis. Table 4 presents the eigenvalues and explains variances obtained from principal component analysis with 47 items.

Table 4. Eigenvalues and Variance Ratios for Components

Factors	Eigenvalues	Explained Variance %	Cumulative Variance %
1	7,569	16,104	16,104
2	5,159	10,977	27,081
3	2,108	4,485	31,565
4	1,951	4,151	35,717
5	1,750	3,723	39,440
6	1,589	3,381	42,821
7	1,458	3,101	45,923
8	1,389	2,956	48,878
9	1,324	2,816	51,695
10	1,210	2,574	54,269
11	1,110	2,362	56,630
12	1,053	2,240	58,870
13	1,037	2,207	61,077

The analyses showed 13 factors with eigenvalues greater than one and explained approximately 61% of the total variance. The acceptable range for factor loadings is stated as 0.32, and items below this value are recommended to be removed from the analysis (Tabachnick & Fidell, 2013). In addition, when an item loads on more than one factor, the difference between the loadings below 0.20 indicates that the items overlap and should be removed from the analysis (Howard, 2016). Accordingly, 27 items were removed from the analysis, and the analysis was repeated with 20 items. The results of the analysis are given in Table 5.

Table 5. KMO and Barlett's Test Results

Kaiser-Meyer-Olkin (KMO)		0,796
Barlett Test	χ^2	1788,006
	sd	190
	p	

The Table 5 shows that the KMO value is at the desired level (>0.60) (KMO=0.796) and Barlett's Test is significant (χ^2=1788.006; p<.01; Tabachnick & Fidell, 2013); the data are suitable for factor analysis. The results of the analysis are presented in Table 6, Table 7, and Figure 1.

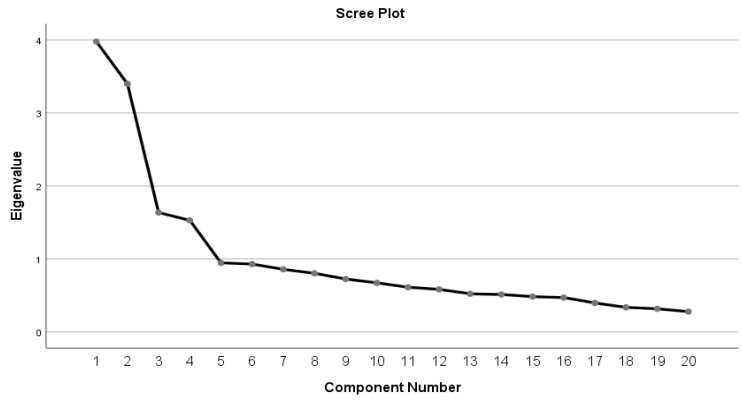

Figure 1. *Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P) scree plot*

In Figure 1, it is seen that the graph experienced a high slope decrease from the Y axis to the X axis 4 times, and after these decreases, the slope decreased, and the eigenvalue fell below 1. This result can be interpreted as the measurement tool has 4-factor structure.

Table 6. Eigenvalues and Variance Ratios for Components

	Factors	Eigenvalues	Explained Variance %	Cumulative Variance %
Beginning	1	3,980	19,899	19,899
	2	3,399	16,997	36,895
	3	1,636	8,180	45,075
	4	1,529	7,646	52,722
Rotation	1	2,956	14,781	14,781
	2	2,684	13,418	28,199
	3	2,652	13,258	41,457
	4	2,253	11,264	52,722

Table 6 shows that the four factors with 20 items explained 52.722% of the variance. This finding is consistent with the literature, which recommended that the explained variance be above 50% (Thompson, 2004).

Table 7. Factor Loadings Matrix for the Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P)

1. Factor		3. Factor	
Item Number	Factor Loading	Item Number	Factor Loading
i1	,490	i17	,659
i2	,556	i18	,748
i3	,797	i19	,744
i4	,797	i20	,793
i6	,673	i21	,484
i39	,565		
2. Factor		4. Factor	
Item Number	Factor Loading	Item Number	Factor Loading
i10	,659	i31	,721
i12	,673	i32	,716
i13	,774	i33	,842
i14	,752	i34	,557
		i36	,699

It was also observed that the item factor loadings ranged between 0.48 and 0.84 and were above the acceptable range of 0.32.

Confirmatory factor analysis was applied with the data obtained from the study group of 200 parents to determine the validation of the 4-factor structure. The obtained goodness of fit indices is presented in Table 8.

Table 8. Goodness of Fit Indices of the Model

χ^2	sd	χ^2 / sd	RMSEA	CFI	TLI
335,60	164	2,05	0,07	0,90	0,89

The goodness of fit allows assessing whether the four-factor scale structure is confirmed using a series of model fit indices. Although the first value in fit indices is the Chi-square statistic, it reasonably fits models with about 200 data. Since the data for the confirmation analyses in the study was obtained from the 200 parents, the χ^2/sd ratio was used to decide the model-data fit. If the χ^2/sd ratio is below five, the fit is assumed to be good. There are also more indices used in this study to evaluate the goodness of fit, such as the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). RMSEA above 0.10

indicates poor fit; CFI and TLI above 0.90 and close to 1 indicate good model fit. This shows that the population covariance matrix and the sample covariance matrix are close (Hu & Bentler, 1999; Tabachnich & Fidell, 2001, pp.720-722). Accordingly, Table 8 states that the RMSEA value was acceptable, and $\chi 2$/ sd, CFI, and TLI indicated a good fit. As a result, it is accepted that ECSCS-P with four factors is confirmed with goodness of fit indices. Figure 2 shows the path diagram of the model.

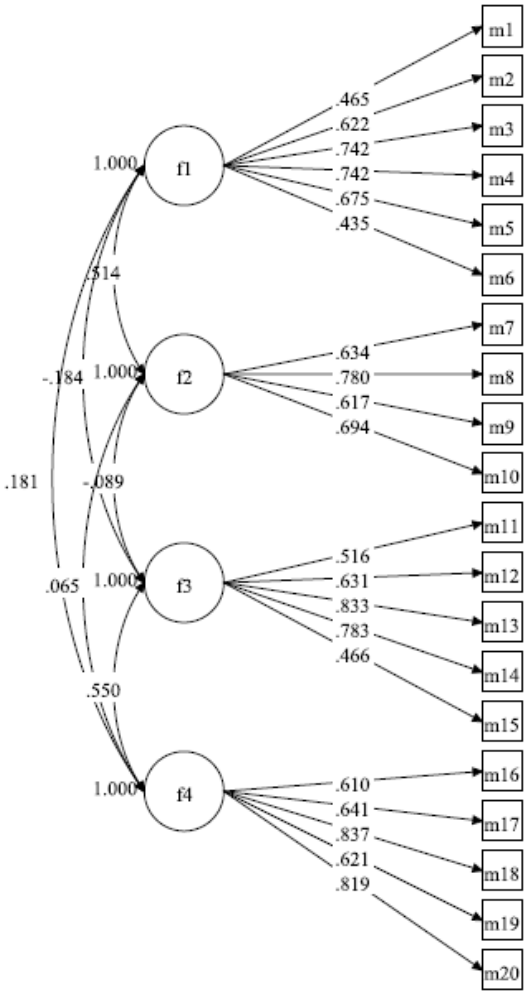

Figure 2. *Path Diagram for Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P)*

The path diagram shows that the item factor loadings are between 0.435 and 0.833 and are at the desired level (>.32). The fit index results and item factor loadings show that the 4-factor 20-item structure was confirmed.

Reliability

The Cronbach Alpha coefficient calculated for the first factor of the scale in the data obtained for the trial application of the scale was 0.755; for the second factor, it was 0.736; for the third factor, it was 0.751; and for the fourth factor, it was 0.766.

According to the data obtained in the study conducted to verify the structure reached in the trial application, the Cronbach Alpha coefficient calculated for the first factor of the scale was 0.745; for the second factor, it was 0.731; for the third factor was 0.742; and for the fourth factor was 0.784. Cronbach Alpha value higher than 0.70 is considered satisfactory (Nunnally, 1978). According to both the analysis results obtained from the trial application and the analysis results made to verify the structure reached, it can be said that the Cronbach Alpha values obtained are satisfactory.

Finally, in order to determine the test-retest reliability of the scale, data were collected again from 25 parents three weeks after they filled out the first form. As a result of the analyses, the Pearson coefficient for the four factors of the scale was calculated as r=0.75 ($p<0.01$), r=0.52 ($p<0.01$), r=0.53 ($p<0.01$) and r=0.51 ($p<0.01$), respectively. A positive and highly significant relationship for the first factor and a positive and moderately significant relationship for the second, third and fourth factors between the repeated measurements was found.

DISCUSSION AND CONCLUSION

Self-compassion, also considered an emotion regulation skill, is a learnable skill (Neff, 2003a). Early childhood is fundamental for developing and strengthening self-compassion, as in all personality traits. Therefore, this study aimed to create the *Early Childhood Self-Compassion Scale-Parent Form* (ECSCS-P) to determine children's self-compassion levels from the early years. Exploratory and confirmatory factor analysis of the ECSCS-P revealed that ECSCS-P has a four-factor structure and satisfying reliability.

The first factor of the ECSCS-P is "*self-kindness*," which includes items such as "My child shows self-compassion when faced with a negative event." "My child talks to himself/herself to console his/her feelings when faced with a negative event (I was upset/angry, but it will pass, I can succeed)"; the second factor is called "*self-caregiving*" which includes items such as "My child relaxes by turning to a job he/she likes when faced with a negative event.", "My child relaxes by going to a place where he/she feels good when faced with a negative event." The third factor, "*over-identification*," includes items such as "When my child encounters a negative event, he/she exaggerates the event." "When my child encounters a negative event, he/she thinks that the negativity will never go away." and "When my child encounters a failure, he/she thinks that he/she is not good enough." The fourth factor includes "My child blames himself/herself when he/she encounters a negative situation" items and is called "*self-criticism*."

The scale characteristics were similar to those of previously developed scales (Bailey, 2020; Neff, 2003) regarding positive and negative factorizations. Self-kindness, self-criticism, and over-identification in ECSCS-P are compatible with the six-factoral Self-Compassion Scale developed by Neff (2003b). Self-Compassion Scale also includes "awareness" and "common humanity" as positive components and "isolation" as a negative component. Awareness is a component that is more likely to be measured through self-report as it is mainly related to acceptance of events (Atalay, 2021; Kabat Zinn, 2021). The ECSCS-P developed in this study also included items related to awareness. However, in the exploratory factor analysis, it had to be removed because its values were below the acceptable range. Awareness is an abstract process that is difficult to observe. The fact that the scale is based on parental observation rather than self-report can be seen as a factor that affects the value of the item loads in the awareness part. Since overidentification, which is the opposite of awareness, has a more observable and concrete structure, low scores on items related to overidentification may give an idea about awareness.

The trial form of the ECSCS-P also included items regarding the common humanity and isolation factors. However, since the factor loadings were insufficient, they had to be removed from the scale form. Children have egocentric thinking tendencies in the early years. (Piaget, 1926). They may tend to see themselves as the source of problems. This can make it difficult for them to understand the common humanity. In addition, a strong bond and trust with parents may allow them to perceive parents as a safe haven and turn to them to solve problems (Bowlby, 1969). For this reason, they can naturally seek support from adults instead of being alone and isolated in the face of difficulties.

Self-caregiving in ECSCS-P consists of items covering the characteristics related to the ability to care for well-being and compassionate behavior, which are included in Gilbert's (2009) theory. The fact that these characteristics can be easily and frequently observed in data collection based on parents' observations may have caused them to be dominant and factorized.

The socio-cultural environment may also have impacted the items and the structure of the scale, depending on the emotional difficulties faced by children in Turkey, parents' emotional and self-compassionate characteristics and behavioral examples, children's behaviors, and parent's perceptions of the process.

This study constitutes the basis for future studies in developing the Early Childhood Self-Compassion Scale-Parent Form (ECSCS-P). Studies reveal that the characteristics of family members, the child's upbringing style, and cognitive factors primarily impact children's self-compassion (Neff, 2003a; Neff & McGee, 2009). The Early Childhood Self-Compassion Scale-Parent Form will be the main measurement tool for evaluating self-compassion in the early years. Another study conducted with young people focused on the effect of childhood experiences on self-compassion and found that parental rejection, overprotection, and low parental warmth predicted low self-compassion through attachment anxiety (Pepping et al., 2015). It was observed that children who grew up with democratic attitudes had higher levels of self-compassion. In comparison, children who grew up with parents with protective and authoritarian attitudes had lower levels of self-compassion (Yılmaz, 2009). Positive parental behaviors, such as parental warmth and autonomy support, are positively correlated with self-warmth and negatively correlated with self-coldness. On the other hand, negative parental behaviors such as

rejection, chaos, and coercion are negatively correlated with self-warmth and positively correlated with self-coldness (Rogers, 2023). Parental criticism affects social anxiety about low self-compassion (Potter et al., 2014). According to these studies, childhood experiences are compelling in terms of self-compassion. Therefore, ECSCS-P can be essential in explaining individual and parental factors that impact the child's self-compassion and planning the most appropriate interventions for the situation. It can be used in experimental studies as well as predictive correlational studies. For example, children's self-compassion can be evaluated before and after parent training programs. Since ECSCS-P is based on parental observation, data collection is also economical in terms of labor and time, and teachers can also benefit from it to make predictions about children's social-emotional characteristics and save them in their portfolios.

Statements of Publication Ethics

Ethics committee approval of the study was obtained from the Ethics Commission of the affiliated university.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Kübra Engin	☒	☒	☒	☒	☒	☒
İlkay Ulutaş	☒	☒	☐	☐	☒	☒

Conflict of Interest

This study has no conflict of interest.

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Examination of Pre-service Science Teachers' and Science Teachers' Mathematical Modeling Competencies

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Abstract

The purpose of this study is to examine the mathematical modeling competencies (MMC) of pre-service science teachers and science teachers towards the use of mathematical modeling (MM) in science education. For this purpose, a qualitative study was conducted with 12 pre-service science teachers and science teachers. A case study design was used in the research. Data were collected through activity forms, interviews, and observation techniques. Descriptive analysis was used to determine MMC by considering the sub-competencies revised by Çakmak (2019) in line with Borromeo Ferri's (2006) MMC. Upon examining the MMC, it was concluded that MMC developed in the process, and the most successful understanding and the least successful ones were simplification and structuring MMC. Contrary to the literature, it was determined that reaching real results from mathematical results was satisfactory. It was observed that newly graduated science teachers and experienced science teachers had an equal level of MMC, while pre-service science teachers had a lower level of MMC. In the process, the least competence was shown in biology and chemistry, and the most competence was shown in physics. It is recommended to increase MM studies for science education, to provide MM courses at least at the undergraduate level, and to experience MM practices through in-service training.

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Keywords: mathematical modeling, mathematical modeling competencies, science education.

Fen Bilgisi Öğretmen Adayları ve Fen Bilgisi Öğretmenlerinin Matematiksel Modelleme Yeterliklerinin İncelenmesi

Öz

Bu çalışmanın amacı, fen eğitiminde matematiksel modelleme (MM) kullanımına yönelik olarak fen bilgisi öğretmen adayları ve fen bilgisi öğretmenlerinin matematiksel modelleme yeterliklerini (MMY) incelemektir. Bu amaçla, 12 fen öğretmen adayı ve fen öğretmeni ile nitel bir araştırma yürütülmüştür. Araştırmada durum çalışması deseni kullanılmıştır. Veriler, etkinlik formları, görüşme ve gözlem teknikleri ile toplanmıştır. MMY'ni belirlemek için, Borromeo Ferri'nin (2006) MMY'ye göre Çakmak'ın (2019) revize ettiği alt yeterlikler esas alınarak betimsel analiz kullanılmıştır. MMY'nin süreç içerisinde geliştiği, en başarılı anlamanın ve en başarısız olanın basitleştirme ve yapılandırma MMY olduğu sonucuna varılmıştır. Literatürün aksine, matematiksel sonuçlardan gerçek sonuçlara ulaşmada problem yaşanmadığı tespit edilmiştir. Yeni mezun fen bilgisi öğretmenleri ve deneyimli fen bilgisi öğretmenlerinin MMY'nin eşit düzeyde olduğu görülürken, fen öğretmen adaylarının MMY'nin daha düşük olduğu görülmüştür. Süreçte en az biyoloji ve kimya, en çok fizik konularında yeterlik gösterilmiştir. Fen eğitimine yönelik MM çalışmalarının artırılması, en azından lisans düzeyinde MM derslerinin verilmesi ve hizmet içi eğitimlerle MM uygulamalarının deneyimlendirilmesi çalışmalarının yapılması önerilmektedir.

Anahtar kelimeler: matematiksel modelleme, matematiksel modelleme yeterlikleri, fen eğitimi.

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INTRODUCTION

The interaction between science and mathematics is a dynamic and synergistic relationship. Mathematics provides the language and tools for expressing analyzing and validating scientific ideas while science in turn inspires the development of new mathematical theories and applications. This collaborative interaction has been fundamental to numerous scientific breakthroughs and technological advancements throughout history. The interactivity between science and mathematics is dynamic and continually evolving, with advancements in one field often influencing and inspiring developments in the other. This interconnectedness underscores the importance of an integrated approach to teaching and learning science and mathematics.

Mathematical modeling (MM) is a method that effectively combines science and mathematics in education. MM is generally defined as the process of expressing, testing and interpreting a mathematical or non-mathematical situation using mathematical language (Kertil, 2008; Kaiser, 2020; Kapur, 2023). It provides essential contributions by making sense of situations encountered in daily life and establishing a connection between mathematics and science (Kaiser, 2007; Başkan, 2011; Guerrero-Ortiz & Mena-Lorca, 2017; Deniz, 2018; Doğan & Gürbüz, 2019; Kaiser, 2020; Kapur, 2023). MM studies are applied in the fields of science and mathematics by associating with real life and help to connect these fields (Prins et al., 2009; Sağlam-Arslan & Arslan, 2010; Doruk, 2010; Başkan, 2011; Guerrero-Ortiz & Mena-Lorca, 2017; Deniz, 2018; Doğan & Gürbüz, 2019; Kapur, 2023).

The boundary between mathematics and science does not reflect modern science's interdisciplinary work, and an innovative curriculum integrating mathematics and science courses should be developed as an alternative to the traditional subject-oriented curriculum. (Michelsen, 2006; Başkan, 2011; Guerrero-Ortiz & Mena-Lorca, 2017; Deniz, 2018; Doğan & Gürbüz, 2019). Bridging the gap between the teachings of these disciplines, including MM in science courses, makes a significant contribution (Başkan, 2011).

The Significance of the Study

Studies show that students' Mathematical Modeling Competencies (MMC) are relatively low (Frejd & Ärlebäck, 2011; Gatabi & Abdolahpour, 2013; Kaiser, 2020; Kapur, 2023). Therefore, educational activities should be organized in this direction. Teachers and future teachers play essential roles in creating and organizing these environments. Teachers must understand MM to organize MM environments. However, studies show that teachers who will organize these environments and pre-service teachers who are future teachers do not even know about MM (Akgün et al., 2013; Anhalt & Cortez, 2016; Işık & Mercan, 2015; Urhan & Dost, 2016; Kaiser, 2020; Kapur, 2023). Teachers expected to use MM must gain modeling experience (Niss et al., 2007). It is impossible for teachers and pre-service teachers who have not received MM training, have never been involved in MM processes, and have not faced activities to acquire MMC (Doğan & Gürbüz, 2019). Studies on teachers' MMC are limited (Zbiek, 2016; Ferri, 2018).

When examining MM studies in the literature, it becomes apparent that there are very few studies in science education. Furthermore, studies on the MMC of science teachers are almost nonexistent (Yenilmez & Yıldız, 2019). A detailed search in the database of the National Thesis Center (https://tez.yok.gov.tr/accessed on 25.03.2023) reveals that there are 855 theses on 'mathematical modeling', and only Başkan (2011) and Güder (2019) have doctoral dissertations on MM in science education. Meta-analysis studies on MM determine that there are very few interdisciplinary and especially science education studies. It is emphasized that MM studies should increase, especially in different disciplines such as science education (Yıldız & Yenilmez, 2019; Koç, 2020; Koceva Lazarova, Stojkovic, & Stojanova, 2022). The starting point of this study is to fill these gaps in the literature and contribute to MM studies by providing an interdisciplinary perspective.

Science teachers should use MM because it enriches the learning experience, enhances problem-solving skills, integrates STEM disciplines, fosters critical thinking, prepares students for future careers, incorporates technology, aligns with inquiry-based learning, develops mathematical literacy, promotes creativity, and addresses complex global challenges (Koceva Lazarova, Stojkovic, & Stojanova, 2022). MM allows students to apply mathematical principles to solve practical problems in various scientific disciplines, such as physics, biology, chemistry, and engineering.

MMC plays a crucial role in science education. Science teachers with modeling competencies can bring real-world applications into the classroom, demonstrating to students how mathematical concepts are utilized to address complex scientific challenges. Teachers with MMC can enrich their teaching practices, provide students with a more comprehensive understanding of science, and better prepare them for future academic and professional pursuits in science and related fields. They can provide a more integrated and holistic approach to teaching scientific concepts. They can demonstrate the practical applications of mathematics in scientific inquiry, making

the learning experience more engaging for students. As educational practices evolve, there is an increasing emphasis on interdisciplinary and practical learning experiences. Teachers with modeling competencies are better positioned to adapt to these trends and incorporate innovative teaching methods into their classrooms.

The Aim of the Study

This study aims to examine the mathematical modeling competencies of science and pre-service teachers by making them experience the MM process.

Research Question

How are the mathematical modeling competencies of pre-service science teachers, newly graduated science teachers and experienced science teachers who have experienced the mathematical modeling?

LITERATURE REVIEW

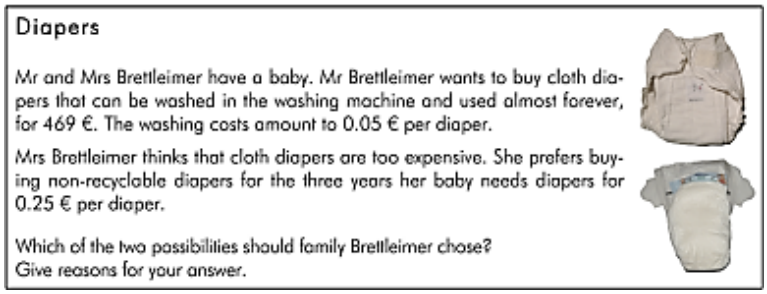
This section presents the contexts related to the research, forming the background of the research, the research bases in line with the literature, and similar studies in the literature.

Mathematical Model

Berry and Houston (1995), in one of the first studies on MM, define a mathematical model as a mathematical representation of the relationship between two or more variables related to a given situation. Lesh and Doerr (2003), prominent figures in MM studies, define the mathematical model as the forms of representation used in explaining, describing or structuring the behavior of specific systems. Çakmak (2019) defines a mathematical model as a generalizable and reusable mathematical representation created to represent a complex real-life situation.

Mathematical Modeling

Although there are many definitions in the literature about the concept of MM, it can be said that all definitions converge on a common denominator as the mathematical expression of a real situation (Doruk, 2010; Haines & Crouch, 2007; Lesh & Doerr, 2003). In addition, MM is the process of creating a model and is expressed as a bidirectional transformation process between the real world and the mathematical world (Blum & Borromeo Ferri, 2009). Sriraman (2006) explains the relationship between the mathematical model and MM as the process of creating a physical, symbolic, or abstract model of a situation, while the mathematical model is the product of this process. On the other hand, Lesh and Doerr (2003) use the concept of model-eliciting activity, which includes both the terms mathematical model and modeling in terms of meaning. An example of a modeling task and modeling steps is presented in Figure 1.


Diapers

Mr and Mrs Brettleimer have a baby. Mr Brettleimer wants to buy cloth diapers that can be washed in the washing machine and used almost forever, for 469 €. The washing costs amount to 0.05 € per diaper.

Mrs Brettleimer thinks that cloth diapers are too expensive. She prefers buying non-recyclable diapers for the three years her baby needs diapers for 0.25 € per diaper.

Which of the two possibilities should family Brettleimer chose?
Give reasons for your answer.

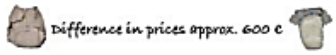
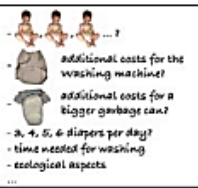
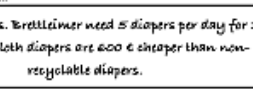
general description	example: the task "diapers"
1. First, the text and maybe a photo have to be read and the problem situation has to be understood by the problem solver, that is an *individual mental model of the real situation* has to be constructed (see section 2.1).	
2. For example by making assumptions or selecting given data the situation has to be simplified, structured and made more precise, leading to a *real model* of the situation.	
3. Based on basic ideas (vom Hofe 1998) of different mathematical concepts, mathematisation transforms this real model into a *mathematical model*.	$y_1 = 469 + 0.05 \cdot x$ $y_2 = 0.25 \cdot x$ $x = 3 \cdot 365 \cdot 5$ $y = y_1 - y_2$
4. Then mathematical tools like rearranging a term or the rule of three are used, yielding a *mathematical result*.	$y = -62.6$
5. By activating basic ideas again, the mathematical result has to be interpreted in the real world as a *real result* for the given problem.	
6. The next step is a *validation* of the real result: Is it reasonable? Is the accuracy appropriate? Are the assumptions/ simplifications adequate? Accordingly, one might go round the modelling loop several times.	
7. The process ends with an exposition of a final answer to the original problem.	

Figure 1. *An example of a modeling task and modeling steps (Lesh & Blum, 2010, p.122)*

Mathematical Modeling Cycles

The mathematical modeling process has multiple cycles, such as reaching a solution using the given data, comparing the solution with a real-life situation, and developing a different solution by improving the solution (Erbaş et al., 2013). It is also represented by a cycle designed according to different perspectives, such as realistic or applied modeling, contextual modeling, educational modeling, socio-critical modeling, and cognitive modeling (Greefrath & Vorhölter, 2016; Perrenet & Zwaneveld, 2012). In the literature, there are diagrammatic representations of MM as a process involving a repeatable cycle, which are similar but differ. When different MM cycles are examined, they include the real situation & problem (modeling situation), mathematical model, mathematical result, and real result steps. However, they differ according to the situation model and real model stages (Çakmak, 2019).

One of the modeling cycles frequently used in MM studies belongs to Lesh and Doerr (2003). In Lesh and Doerr's modeling process, unlike other studies, a complete circularity draws attention. In this study, it is seen that there is no hierarchy between the steps in the MM process, and it is not stated that all steps are interrelated. Doerr's MM cycle is presented in Figure 2. The modeling cycle consists of four fundamental steps: (a) Description: transferring the given real-life situation to the modeling world, (b) Manipulation: applying and calculating the model that emerges after transferring to the modeling world, (c) Prediction: transferring the obtained results back to the real world, and (d) Validation: verifying the usefulness of the predictions.

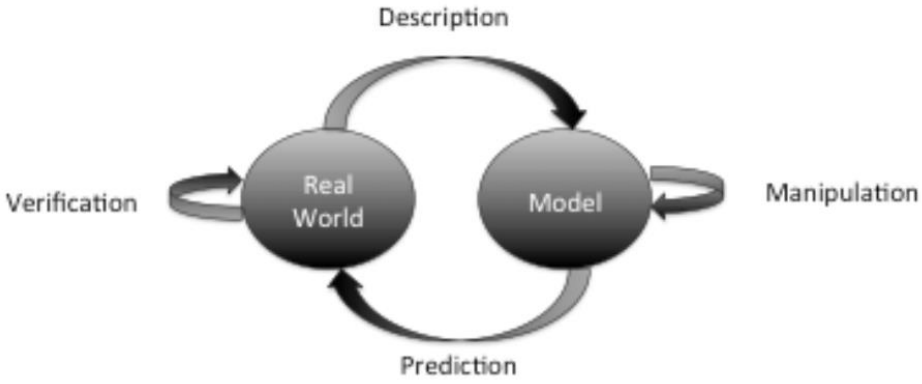


Figure 2. *The nodes of the modeling process (Lesh and Doerr, 2003)*

Unlike other studies, Borromeo-Ferri (2006) integrates the situation model, i.e., the mental representation of the situation, into the process in the MM cycle and presents the real situation, the situation model, and the real model separately. While this modeling cycle shown in Figure 3 consists of six steps, the presentation activity, which is the stage of returning from the mental representation of the situation to the real situation, is not included in the modeling process as a cognitive stage. Çakmak (2019), as a result of his detailed literature review, states that the situation model is not mentioned in the modeling cycles presented until Borromeo Ferri's cycle. This study, which examines the modeling cycle in more detail than others, focuses on the cognitive processes of individuals (Ural, 2018; Çakmak, 2019; Çoksöyler & Bozkurt, 2021).

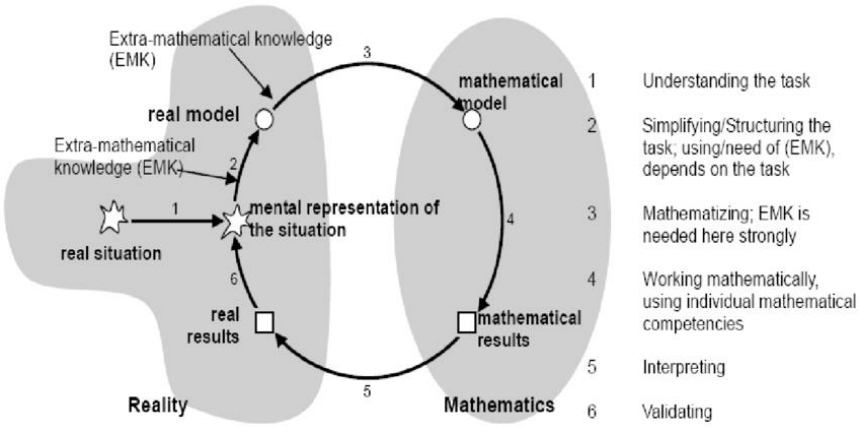


Figure 3. *Borromeo Ferri's (2006) Modeling Cycle*

Borromeo Ferri's (2006) modeling cycle, which deals with the cognitive aspects of the modeling process, seems to be a suitable tool for analyzing the cognitive processes of the participants because it is very detailed and prone to the use of different modeling types (Blum & Leiß, 2007; Tutak & Güder, 2014; Çakmak, 2019; Çoksöyler & Bozkurt, 2021). It was decided to use the MM cycle constructed by Borromeo Ferri (2006) in this study due to the importance of cognitive processes in science subjects and the fact that it allows for detailed and comprehensive analysis.

Mathematical Modeling Competencies (MMC)

According to Kaiser and Brand (2015), studies on modeling competencies are organized in line with the following general questions:

1) How can modeling competencies be conceptualized?
2) How can modeling competencies be tested?
3) How can modeling competencies be developed?
4) How can modeling competencies be fostered most effectively?
5) What assessment methods are appropriate in practice to assess modeling competence?

First of all, in order to understand the MMC of pre-service and in-service science teachers, the main objectives of this study, it is necessary to explain what mathematical modeling competency means in the literature. Competence and skill are two MM concepts frequently used in MM studies. Although these two concepts are used as alternatives to each other in many studies, there are semantic differences between these two concepts (Bukova Güzel, 2019). In TDK (2021) dictionary, *skill* is defined as a person's ability to accomplish a job depending on predisposition and learning and to finalize a process following the purpose, while *competence* is defined as exceptional knowledge, license, and sufficiency that provides the power to do a job. Tekin Dede (2018) defines skill as the organization of individuals' existing abilities to enable them to reach a goal depending on education, and competence as having the necessary equipment to achieve a goal. When MM studies are examined, it is seen that literature has recently emerged to define and develop modeling competencies, but a complete consensus has not yet been reached (Maaß, 2006; Çetinkaya, 2013; Kaiser & Brand, 2015). Maaβ (2006) describes modeling competencies as the goal-oriented skills and abilities that enable the modeling process and the willingness to exhibit these skills and abilities.

Bukova Güzel (2019, p.42) states that MMC in the literature is addressed from four different perspectives listed below.

1) Cognitive competencies

2) Metacognitive competencies

3) Affective competencies

4) Social competencies

Social Competencies: It is known that the MM process takes place in a learning environment as individual or group work. From this point of view, individuals participating in the process should have competencies such as being able to communicate, express themselves, work with the group, take responsibility, discuss, present their work, and share (Kaiser, 2007; Kaiser et al., 2010; Kaiser & Brand, 2015; Bukova Güzel; 2019, Çevikbaş, Kaiser, & Schukajlow, 2021).

Affective Competencies: While defining modeling competencies, Maaβ (2006) emphasizes the willingness of individuals towards the MM process, that is, the factors of voluntariness and motivation. Biccard and Wessels (2011) state that people involved in the MM process develop their beliefs and perceptions about the nature of the problem. In addition, as mentioned in the following stages of this study, one of the principles of mathematical modeling activities (MMA) is that MMA should make individuals feel the need to create a model, which can be said to be related to affective competencies.

Metacognitive Competencies: Metacognitive competencies include factors that support cognitive competencies such as knowing the MM process, planning, monitoring, controlling, verifying, judging the solution, reflecting, creating real-life problems, analyzing the task, and using the sense of orientation (Tanner & Jones, 1995; Maaβ, 2006; Kaiser, 2007; Ferri, 2011; Çakmak, 2019; Bukova Güzel, 2019).

Cognitive competencies: These include cognitive skills such as understanding the problem, simplification and structuring, mathematization, mathematical work, interpretation and verification, which cover the entire modeling process and occur during the process (Çakmak, 2019; Bukova Güzel, 2019).

Examining this study regarding cognitive competencies in the modeling process was deemed appropriate for determining the MMC of pre-service science teachers and teachers. In this context, the theoretical framework was advanced through cognitive competencies.

In the literature review, situations that may affect the development of MMC were identified (Anhalt & Cortez, 2016; Biccard & Wessels, 2011; Blomhøj & Jensen, 2003; Brand, 2014; Galbraith & Stillman, 2001; Ji, 2012; Kaiser & Grünewald, 2015; Kaiser et al, 2010; Kaiser & Stender, 2013; Maaß, 2006; Çakmak, 2019; Geefrath, 2020, English, 2006; Antonius, Haines, Jensen, M. Niss, & Burkhardt, 2007, Zawojewski, Lesh, & English, 2003). Some of these situations are as follows;

1) Information about mathematical model, modeling, and modeling cycle:

2) Group work

3) Content of modeling situations,

4) Preparation of teaching environment for holistic or atomistic approach

5) Technology use

6) The role of the teacher

7) Long-term studies

Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review.

METHOD

The method section includes the research design, the study group or participants of the study, data collection tools, and data analysis.

Research Design

Henning and Keune (2007) state that MMC cannot be directly observed, and that competencies can only be determined by observing the actions and behaviors of students or teachers while performing MM tasks. In this direction, it was decided to design the study according to the case study design, which is one of the qualitative research methods that enable detailed and in-depth investigations to examine the MMC of pre-service science teachers and teachers. This method enables close observation of the process and the actions and behaviors within the process. The case study is a design in which the researcher examines one or more situations limited in time in depth with data collection tools including multiple sources, investigates with a holistic approach, and defines situations and themes related to the situation (Creswell, 2013; Şimşek & Yıldırım, 2018).

In learning environments where the holistic approach is adopted, the aim is to enable individuals to go through the whole mathematical modelling process. In learning environments where the atomistic approach is adopted, the aim is for individuals to perform a sub-step or particular steps of the mathematical modeling process. In this study, a holistic approach is used due to evaluating the entire process by considering sub-competencies.

Study Group

The purposive sampling (non-probabilistic sampling) method was used in the study. The purposive sampling method aims to examine a subject in depth based on the research group selected for a specific purpose (Yıldırım & Şimşek, 2018). Three groups were formed to observe whether professional experience affects mathematical modeling competencies. The research group consisted of four pre-service teachers attending the fourth year of the Department of Science Education, four science teachers who have a bachelor's degree in science teaching but have not been appointed, and four experienced teachers who continue to teach science in public schools affiliated with the Ministry of National Education. This research group was formed by considering the criteria of completing physics, chemistry, biology, and mathematics courses in science education at the undergraduate level and their experience in the science teaching profession.

All participants signed the consent form that they voluntarily participated in the study. In the study, pre-service science teachers were coded as U1, U2, and U3; teachers who received a bachelor's degree in science teaching but were not appointed were coded as P1, P2, and P3; and teachers who continue to teach science in public schools affiliated to the Ministry of National Education were coded as T1, T2, and T3. Demographic information about the participants is shown in Table 1.

Table 1. Demographic information about the participants

Participant	Gender	Professional Experience (Years)	Education Level	MM Experience
T1	Male	10	PhD Student	-
T2	Male	9	Master's degree graduate	-
T3	Male	9	PhD Student	-
T4	Male	11	Bachelor's degree	-
P1	Female	3	Graduate Student	-
P2	Female	-	Graduate Student	-
P3	Female	1	Graduate Student	-
P4	Male	-	PhD Student	-
U1	Female	-	4th Year Undergraduate	-

U2	Female	-	4th Year Undergraduate	-
U3	Female	-	4th Year Undergraduate	-
U4	Female	-	4th Year Undergraduate	-

Data Collection

In this study, the Activity Form, developed by Kenan and Polat (2022), was used as the data collection tool. The 'Activity Form' incorporates Borromeo Ferri's (2006) MM steps. The activity reflective diary form presented in Appendix-1 was used as another data collection tool. The form is a structured interview form that collects participants' feelings and thoughts during the activity.

Additionally, the observation technique was used to monitor the cognitive skills of pre-service science teachers and teachers in the learning environment created to examine their MMC. Observation is a technique used to describe in detail the behaviors occurring in any environment (Yıldırım & Şimşek, 2018). The most significant advantage of this technique is that it enables many behaviors to be objectively determined by observing the individuals in their natural environment (Karasar, 2016). The researcher and an expert with a PhD in MM took part as observers in the implementation process. For six weeks, two observers monitored the groups. The data transferred by the groups to the activity forms were continuously compared with the observation notes.

Process

The implementation of the research was designed by considering the situations that enhance MMC.

Information about model, modeling and modeling cycle: Experts in MM educated the pre-service science teachers and teachers who constituted the study group. The participants were received training in MM during these informative activities, which lasted an average of 2 hours and were video recorded.

Group work: As the literature suggests that group work is crucial in the development of MMC, the modeling environment of this study was organized by forming groups of four people.

The content of modeling activities: In the study, six MMA developed by Kenan and Polat (2022), considering Lesh et al.'s (2000) principles for developing thought provoking activities, were used. Care was taken to ensure that the contents of the mathematical situations were related to real life, at least at the undergraduate level, within the knowledge domain of teachers and pre-service teachers, involving more than one variable, and open to interpretation and elaboration.

Table 2. Mathematical modeling activities

Activity Name	Code	Learning Area	Learning Area Subject(s)
Melisa Project	MP	Biology	Photosynthesis, Respiration, Life Cycle
Reflux	RE	Chemistry	Acids and Bases, Neutralization Reactions
Houseboats	YE	Physics	Center of Gravity, Mass, Density, Buoyancy,
Plastic Bacteria	PB	Biology	Bacteria, Enzymes, Recycling
Ozone	OZ	Chemistry	Chemical Reactions, Environmental Pollution
Slide	KA	Physics	Kinetic and Potential Energy, Speed, Incline

Unlike the literature, the modeling activities developed by Kenan and Polat (2022) were presented in video format. This decision was based on the idea of engaging more senses, associating more efficiently with real life, including motivational elements, and integrating with technology. For example, the 'Reflux' activity, derived from the 'General Chemistry: Principles of Chemistry with a Molecular Approach -1 / Principles of Chemistry: A Molecular Approach' book published by Nobel Academic Publishing, was presented as a video interview using internet resources. Similarly, the Floating Houses activity, initially a verbal situation in a newspaper article (https://www.trthaber.com/haber/dunya/amsterdam-kanallari-uzerinde-yasam-438695.html), was presented using a promotional video of an actual floating houses project built on water in the city of Amsterdam, found through internet resource search.

''I noticed-curious'' activities were added to the process to make the modeling task more comprehensible. QR codes for accessing the videos of these six activities, which were deemed appropriate for use in this study, are given in Appendix 2.

Preparation of teaching environment according to holistic approach: In this study, we examined the competencies of science and pre-service teachers in the MM process and to tracked their development. We used a holistic approach, evaluating the entire process by considering sub-competencies.

Long-term studies: This study lasted eight weeks. The first week involved training in MM, followed by a sample mathematical modeling activity in the second week. For the remaining weeks, six mathematical modeling activities were conducted.

Teacher Role: Academics who were conducting Physics, Chemistry, and Biology courses at the undergraduate/graduate level in Science Education served as consultants in this study. These experts participated in the process alongside the students. This role, defined as an agent in the teaching experience methodology, was undertaken by academics who are experts in the subject area. Before each application, the expert in MM, the agent, and the conductor of the study exchanged ideas on potential questions related to the activity topic, what questions should be asked, what to pay attention to, and additional information and limits that could be shared with the participants. The team also met after each implementation to evaluate the process.

Use of Technology: During the study, which was conducted through the Zoom program, participants were encouraged to access internet information resources, use Office programs such as Excel, Word, PowerPoint, and similar Office programs, make calculations with the help of computers, and access activity content. The groups were able to monitor, share, and present their work through the use of digital documents.

Data Analysis

Descriptive analysis was used in the data analysis of the examination of the MMC of pre-service science teachers and teachers. Descriptive analysis involves interpreting the theoretical framework of the study, the research questions, and the dimensions in the interview or observation according to the performed themes (Yıldırım & Şimşek, 2018).

This study analyzed data according to Borromeo Ferri's (2006) MM cycle. Thus, it was determined at which stage pre-service science teachers and teachers were in the MM process. Ferri's 6-stage coding system consists of 'Understanding' (mental representation of the situation) stage 1, 'Simplification and Structuring (real model stage) 2, 'Mathematization' (mathematical model) 3, 'Mathematical Study' (mathematical result) stage 4, 'Interpretation' (real result) 5 and 'Verification' (validating) 6. The definitions and indicators of the levels of the MM cycle used in this study are presented in Table 3.

Table 3. Indicators of the levels of the mathematical modeling cycle

Stage	Competency	Cod	Indicators
Mental Representation of the Situation	Understanding	1.Stage	Understands the real-world situation and creates a mental representation of the situation, but cannot perform the skills of structuring, simplifying, making assumptions, and predicting.
Real Model	Simplification/Structuring	2. Stage	Makes assumptions about the modeling situation, simplifies and structures the situation, determines the variables and makes predictions about these variables. However, cannot mathematize.
Mathematical Model	Mathematization	3. Stage	Establishes the mathematical model and creates a mathematical problem. However, cannot solve the mathematical problem.
Mathematical Result	Mathematical Study	4. Stage	Solves the mathematical problem and gets the mathematical results. However, cannot make the transition to real results.
Real Result	Interpretation	5. Stage	Interprets mathematical results and get real-world results. However, cannot test their validity.
Validating	Validation	6. Stage	Tests the accuracy and validity of real results in the real world.

To determine the MMC of pre-service teachers and teacher groups in each MMA, the MMC and sub-competencies criteria developed by Borromeo Ferri (2006), adapted by Blum and Kaiser (2006) and revised by Çakmak (2019) were used. These competencies and sub-competencies are presented in Appendix-3.

The coding system and MMC and sub-competencies criteria determined which competency and MM stage the groups participating in the study could reach. Insufficient, partially sufficient, and sufficient dimensions were created for each stage and MMC. Groups observed to be insufficient were evaluated in a sub-stage and competency. For example, if a group identified the variables affecting the situation and made predictions about them, they performed sufficiently in the second stage (real model/simplification and structuring competency). However, if they identify some of the variables affecting the situation and make predictions only about them or if they identify only the variables and cannot make predictions, they show partially sufficient performance in the second stage. If the participants could not identify the variables directly affecting the situation, they were evaluated in the insufficient performance category. If they did not perform the competencies in question, it was accepted that they could not transition to this stage. In this case, the group was evaluated in the first stage, which is a sub-stage.

Validity

There are various strategies to ensure the validity of qualitative studies (Creswell & Miller, 2000). These strategies and their effects on the study are as follows;

Data triangulation: Multiple and different sources are used to ensure the validity of the findings of a study (Miles & Huberman, 1994). In this study, data diversity was ensured and validity was increased by using different data collection tools such as observation, interview, and document analysis.

Long-term interaction: Long-term observation in qualitative studies allows participants to build trust, recognize the culture, and check misinformation originating from the researcher (Glesne, 2016). The implementation of this study lasted eight weeks and is a long-term study. In addition, the data analysis was carried out over approximately one year; repeated analysis, evaluation of the data by different experts, and referring to the literature as a result of the emerging discrepancies are indicators that the field has been studied for a long time.

Expert review: The data related to the determination of mathematical modeling competencies were evaluated separately by the researcher and an expert with a doctorate in mathematical modeling. The subject area expert's approval was requested for the MMC evaluation in the relevant activity.

Reliability

Table 4 indicates the percentages of agreement, disagreement, and agreement between the analyses in each analysis. The coding was done by the researcher and an expert with a PhD in MM. The percentage of agreement between the analyses, i.e., the inter-rater reliability coefficient, was calculated using the formula [agreement/(agreement+disagreement)*100] proposed by Miles and Huberman (1994). The data that did not agree were subjected to re-analysis and a common decision was reached as a result of the discussions. It is stated that the reliability of coding for a qualitative study should be at least 80% agreement (Miles & Huberman, 1994). When the percentages of agreement in the study are examined, it is seen that the values are 85% and above.

Table 4. Agreement between analyses

Analyses	Coders	Agreement	Disagreement	Compliance Percentage (%)
Competencies	2 experts	34	2	94
Sub- competencies	2 experts	310	32	91

Two disagreements emerged when evaluating the stage of pre-service science teachers and teachers in MMC. One of these disagreements was expressed as the T group's 'Plastic Bacteria': "experienced teacher group determined the variables but could not make a transition to the second stage because these variables did not contribute to the problem situation they determined". As a result of the discussion between the coders, it was decided that they made a partial transition to the second stage.

Research Ethics

The pre-service science teachers and teachers participated in the study voluntarily. Accordingly, they read and signed a consent form. Each participant was given detailed and identical information about the research processes during the research. The personal information of the participants was kept confidential, and the codes assigned to them (T1, U1, P1) were used in reporting the data.

FINDINGS

This section presents the findings of the study, which examines the mathematical modeling competencies of pre-service teachers, newly graduated teachers and experienced teachers. The findings are presented in chronological order of the activities. First, the MMC of the groups related to the Melisa Project activity is examined, and finally, the MMC of the groups related to the Slide activity is examined. The findings obtained from the participants' reflective diaries recorded at the end of each activity support the analysis of MMC. The data obtained from the activity forms and video recordings of the participants are given as direct quotations.

Findings on Melisa Project Activity

Based on the data obtained, the general evaluation of the MMC of the groups in the Melisa Project activity is shown in Table 5. In the analysis of the groups' performances in the Melisa Project, it was concluded that the groups understood the problem situation but could not perform the skills of structuring, simplifying, making assumptions and predicting. Therefore, it was determined that the groups remained in Stage 1 and could not exhibit

simplification and structuring competencies. In other words, the groups realized the mental representation of the situation but could not reach the real model (Stage 1).

Table 5. MMC of the groups in the Melisa Project activity

MMC	Insufficient	Partially sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring	T, P, U		
Mathematization	T, P, U		
Mathematical work	T, P, U		
Interpretation	T, P, U		
Validation	T, P, U		

When analyzing the participants' reflective diaries of the activity, we find clues as to why the groups could not access the real model. For example, T3 from group T stated that the model they created was insufficient and that they could not reach essential variables and use the variables in the model as follows;

T3: The model we created is not a good model. We could make a much better model, but we need to come together again at different times to work on it. In addition, we need to reach variables that are very important for the model (for example, the amount of O2 consumed daily by an astronaut, the amount of H2O created).

Similarly, P2 from group P stated that he had difficulties in identifying the factors that significantly affected the problem situation;

P2: In this activity, we had great difficulty in determining the factors that would ensure the continuity of this cycle while dealing with the mouse-algae relationship for nutrient production.

P3, also from the P group, stated that they constantly encountered different variables and that this situation led to a complicated path;

P3: At first, I had difficulty determining the point we would focus on. After receiving the necessary feedback, we started to focus on the point we would focus on. We created the equation. While making comments on the equation, different variables were constantly appearing in front of us. While talking about these variables led us to a more complicated path, it would not be useful to go into too much detail. T1 from the T group implies that they tend to solve the problem directly.

T1: We built the model directly from the conservation of mass in chemical reactions based on the amount of carbon dioxide required for the amount of oxygen needed and neglected all external factors. The model is not inclusive enough in this respect.

The findings obtained from the activity forms, video recordings and reflective diaries show that the groups needed help in simplifying and structuring the problem in the Melisa Project activity, that is, at the real model stage. The groups tended to solve the problem directly. Participants had difficulties in the processes of identifying variables, simplifying the problem, and determining the relevant assumptions.

Findings on Reflux Activity

Based on the data obtained, the general evaluation of the MMC of the groups in the Reflux activity is shown in Table 6. It is observed that the groups understood the problem situation, made assumptions about the modeling situation, simplified and structured the situation, determined the variables and made predictions about these variables but could not mathematise. The T and P groups progressed to the real model step, which is the second step. It can be concluded that both groups understood the modeling situation by making a mental representation of the situation and obtained the real model based on this, but could not make a transition to the mathematical model. Therefore, the groups could not create a valid mathematical model and could not progress to the other steps correctly. While using the data related to the problem, they could not use a solution path that would lead to a solution to the problem.

Table 6. MMC of the groups in the Reflux activity

MMC	Insufficient	Partially Sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring	U	P	T
Mathematization	T, P, U		
Mathematical work	T, P, U		

Interpretation	T, P, U
Validation	T, P, U

The reflective diaries provide clues about why the groups could not access the real model. For example, T3 and P3 stated the following;

T3: Again, we had to do logarithmic operations while designing this model. I did not have any experience with such operations. This situation made us very difficult.

P3: We determined the critical values for neutralization, which will form the basis of the model. We calculated the molar value of baking soda added to water based on the information we gained here. Similarly, we determined how many grams of 20 ml of stomach acid were required using its molarity. We had much difficulty doing these operations; although we did research, we still had difficulty. I realized that mathematical operations are also significant for such models.

In the reflux activity, participants from all groups reported deficiencies in chemistry subjects, difficulty remembering the subjects, and problems in the MM process. T3 stated that he had trouble remembering the chemistry knowledge he acquired during his undergraduate education because he did not use it in his professional life;

T3: I realized that I needed to remember the concepts such as molarity, mole, and molecular weight, which I learnt during my undergraduate education but rarely used in my professional life, and I could not use them sufficiently.

Findings on Houseboats Activity

The general evaluation of the MMC of the groups in the Houseboats activity is shown in Table 7. Upon analyzing Table 7, it is evident that the groups improved their competencies compared to the previous activities. While the T and P groups tested their mathematical working competencies for the first time, the U group tested their mathematization competencies for the first time. The U group remained in the real model stage, which is the 2nd stage, while the T and P groups progressed to the mathematization stage, which is the 3rd stage. Group U made assumptions about the modeling situation, structured it by simplifying it, identified the variables, and made predictions about them, but could not mathematise. The T and P groups, on the other hand, established the mathematical model and created a mathematical problem but could not solve the mathematical problem.

Table 7. MMC of the groups in the Houseboats activity

MMC	Insufficient	Partially Sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring		U	T, P
Mathematization	U	T, P	
Mathematical work	T, P, U		
Interpretation	T, P, U		
Validation	T, P, U		

When the reflective diaries of the participants about the activity are examined, clues about why the groups were insufficient in mathematization and mathematical study competencies emerge. Group U, which progressed to the mathematization stage but could not create a mathematical model, could not create a model because they could not establish the relationship between concepts and variables. For example, group member U2 made the following statement;

U2: Actually, we found all the necessary information, the concepts of surface area or weight that pressure depends on, but we could not gather them in a formula due to lack of information. In this activity, we were weak in creating formulas.

T3 from the T group, who progressed to the mathematical results stage but was insufficient, emphasized that they had difficulty in unit conversions and attributed this to why they made incorrect operations. T3's statement is as follows;

T3: While calculating, we tried to develop the formula Weight=Lifting force. We had a lot of difficulty in unit conversions in the sinking volume we used to calculate the buoyancy force and made many incorrect operations. Using tools such as Excel for all modeling examples may be helpful.

The members of P, another group that progressed to the stage of mathematical work, similarly drew attention to the problems they experienced in determining and converting units. For example, group members P2 and P3 made the following statements.

P3: The part we have difficulty with is that we did not make data transformations while making assumptions.

P2: One of my difficulties was forgetting where the units used in the formula should be converted.

Findings on Plastic Bacteria Activity

The general evaluation of the MMC of the groups is shown in Table 8. When Table 8 is examined, all groups failed to demonstrate the mathematization competencies of the MM process. While there was a decrease in their competencies in the Houseboats activity, which was the previous activity, it is observed that there was an increase in their competencies compared to the Melisa Project, which is another activity related to the subject of biology.

Table 8. MMC of the groups in the Plastic Bacteria activity.

MMC	Insufficient	Partially Sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring		T, U	P
Mathematization	T, P, U		
Mathematical work	T, P, U		
Interpretation	T, P, U		
Validation	T, P, U		

All the groups were able to progress to the real model stage, stage 2. They could understand the modeling situation and create a mental representation of it, but they needed assistance to transition to the mathematical model. They did not use a solution path that would solve the problem when using the related data. Therefore, they needed help to create a valid mathematical model or to correctly complete the other steps. Inadequacies in the first steps of modeling negatively affected the subsequent steps.

This activity provides clues as to why they could not reach the real model and solutions in the modeling process. For instance, group T could not present a real model be presented due to excessive simplification. T3' opinion on this situation is as follows;

T3: We prepared a model with the temperature values of the seasons as variables. However, we should have included many variables, such as the pH value of the environment, the amount of oxygen, and the type of bacteria. I was not comfortable making these omissions. I thought inwardly that these variables were crucial and should be addressed. However, we had no data on the neglected variables to test the model. Therefore, it took work to decide whether these variables were influential or not. Although we did not want to, we increased the number of omitted variables.

Group U had problems organizing and simplifying the variables they identified.

U2: We created a formula, but again there were missing things because our formula was working on the numbers, we determined ourselves, but we did not test how the formula works when there is any change, and we were again insufficient in this regard. Everything is what we know or what we can do, but when it comes to the formula, we did not know what and how to use it, so we had difficulties in creating a formula.

Findings on Ozone Activity

Table 9 shows that the teacher groups successfully performed in all MMC for the first time and completed the process. Group U, on the other hand, was evaluated as insufficient in the following process because they did not perform adequately in MMC. Group U was able to reach the simplification and structuring stage, Stage 2.

Table 9. MMC of the groups in the Ozone activity.

MMC	Insufficient	Partially Sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring			T, P, U
Mathematization	U	T	P
Mathematical work	U		T, P
Interpretation	U		T, P
Validation	U		T, P

Group U could understand the modeling situation and create a mental representation of it, but they needed help to transition to the mathematical model. Groups T and P completed all stages of this activity. It is observed that the groups that can transition to the mathematical model can transition to mathematical results, and the groups that can transition to mathematical results can progress to real results.

When the reflective diaries of the participants regarding the Ozone activity are analyzed, three main clues emerge as to why the U group could not access the real model. Firstly, as a group, they needed more knowledge about the subject, and therefore, they spent their time on research and data collection. Secondly, they needed help in mathematising the relevant quantities and the relationships between quantities. Since the group could not mathematise the problem, they went for an immediate solution. Thirdly, the affective problems they experienced affected them in the modeling process. The opinions of Group U about their need for sufficient knowledge on the subject are as follows.

U2: … I had heard about CFC gas in chemistry class before. I had coded it in my mind as a gas coming out of refrigerators. I had no information about its harm or benefit. When we started the problem, we encountered a lot of CFC gas. I tried to find enough data, but my searches did not give me very clear data

U3: … In fact, at first glance, it seemed easy because I thought that if we calculate the cfc emission and proportion its effect on the Ozone layer, we could find the effect. Since we did not have much information about cfc, we did research from the meteorology page and various sites.

Some of the opinions about the affective problems that prevented the group from reaching the real model are as follows;

U1: I tried to find enough data, but my searches did not provide very clear data." I felt that "we will not be able to solve the problem." I felt very insufficient, and I was insufficient anyway.

U2: Our mistake was to be too hasty in searching for data and to give up immediately when we could not find any. Once we felt that "It will not happen, we cannot do it", we stopped and used to believe in ourselves. That is why we did not achieve any results.

When the opinions of the T and P groups, who reached the real model and results in the ozone activity, are analyzed, it is seen that the problems experienced by the participants are because what they learnt in chemistry subjects did not go through a meaningful and permanent learning process. In addition, their inability to make unit conversions correctly, which was also observed in previous activities, creates problems in the MM process.

P1: This activity was the most difficult, the longest, we could not find a common point, and we thought too much and even burned our brains. The reason was not knowing analytical chemistry, I think I was incomplete. Yes, we had an idea, we knew the way to go, we knew what we needed to do, but when we came to the model, we got stuck. We did a lot of research and finally made a modeling, was it a definite solution? No, it was not. When you think about it, it was a very broad subject, we had a chemical equation, what would we do now? I was thoroughly confused.

P2: Since we sometimes overlooked that the units should be the same in the formulas we used in the activity, errors occurred in the operations. This again caused our activity process to be prolonged.

T3: The most difficult point in this activity was to put the formulas we use in chemistry into practice. There needed to be more than just knowing the formula to be used to solve that operation. We initially thought that the solution would be solved with the concept of mole, but we had a lot of difficulty in the process time due to the fact that we did not record the operations in order.

T1: We realized that we used some data in the wrong places in the formulas to be used in calculating the law of multiple ratios and mole concepts in chemical reactions. I think this is because we forgot how to use the formulas. For example, in the formula n = m / ma, we should have taken the atomic weight for the ma of Cl, but we took a different value.

Findings on Slides Activity

The MMC of the groups in the slide activity are shown in Table 10. The groups performed sufficiently in all stages of the MM process. All groups understood the modeling situation and transitioned to the mathematical model. The groups that were able to make a transition to the mathematical model were able to make a transition to mathematical results, and the groups that transitioned to mathematical results were able to progress to real results. All stages in this activity were completed by the groups.

Table 10. MMC of the groups in the Slides activity.

MMC	Insufficient	Partially Sufficient	Sufficient
Understanding			T, P, U
Simplification and structuring			T, P, U
Mathematization		T, U	P
Mathematical work			T, P, U
Interpretation			T, P, U
Validation			T, P, U

Some of the participants' opinions about the overall process in the Slide activity are as follows;

P1: I think this activity was the easiest, the lack of numerical data made me nervous, but we created this model the easiest. I think the reason is that it was the last activity and we now know what needs to be done more easily. In the first activity, we were like fish out of water, we were thinking what will happen now why are we here, but now it was not like that, but we had a very good command of each step, our activities took a long time, but we had learnt the stages.

T1: In this problem, which I initially thought that I would not be able to solve, I saw that the solution could be reached by focusing on the right variables affecting the situation and using the theoretical knowledge correctly. As a result of this activity, I believe that even a very difficult problem that depends on many variables can be easily solved with mathematical modeling as a result of thorough and detailed thinking.

U3: Of course, we decided to move in this direction by thinking about what our teachers asked, we valued some things, we realized a little late that these assumptions of ours were not actually necessary. When we realized, we came to the conclusion that the formula we had was completely wrong. We had to redesign the whole thing from scratch. We started from the beginning with an inclined plane and formulas. This time we proceeded by finding a new formula over the formula for everything we did not know. Now everything started to settle down and we said and realized our mistake.

T3: The fact that the modeling was done in a certain process made our work much easier. It is obvious that if the stages of the processes are not separated, the assumptions will increase and more erroneous and general modeling will be created.

In examining the group members' opinions about the transition process to the real and mathematical models, it is understood that the model they obtained did not work because they could not determine the relevant variables and assumptions correctly at the beginning. They could not reach the real model since they tried to solve the problem directly by focusing on the mass variable. By increasing their knowledge of the subject, concentrating on the questions of the guide and spending extra time, they were able to create a real model this time. They succeeded in the MM when they identified the relevant variables and revealed the relationship between them. In addition, the fact that they frequently encountered MMA and mastered the process is a fundamental reason for their success. Since the subject is related to physics, the activity is initially perceived as accessible. The reason for this is the presence of fewer variables in Physics subjects than in Biology and Chemistry subjects. Some of the participants emphasized the inadequacy of their knowledge of mathematics content. In addition, making assumptions by focusing on the correct variables affecting the situation in the problem, that is, simplifying and structuring the problem situation correctly, is another reason for their success in this process. Finally, it is implied by the participants that there should be no time constraints in these high-level activities.

DISCUSSION & CONCLUSION

This study examines the mathematical modeling competencies of pre-service science teachers and teachers, discussing each competency separately.

Understanding competence

This study revealed that all groups successfully performed in the understanding competences. Similarly, in the literature, it is seen that individuals or groups involved in MMP do not have problems achieving understanding competence (Türker et al., 2010; Bukova-Güzel, 2011; Çiltaş, 2011; Ji, 2012; Gatabi & Abdolahpour, 2013; Kol, 2014; Çakmak, 2019; Derin & Aydın, 2020). In this study, it can be said that the activities of "I noticed-curious" under the guide's leadership and the discussion environment on MME at the beginning contributed positively to understanding the problem. However, the groups did not demonstrate the sub-competency of drawing the representation of the problem situation in any activity. The video-based modeling activities present mental

representation. Because video-based modeling tasks are seen to have authentic features regardless of whether they contain real-world evidence or not, they provide the opportunity to explore the problem situation (Greefrath & Vos, 2021).

Simplification and structuring competence

The findings obtained from the activity forms, video recordings, and reflective diaries show that the groups struggled with simplifying and structuring the problem. The pre-service science teachers were unable to simplify and structure the problem situation in two activities (MP and RE), and the teacher groups struggled with the same issue in one activity (MP). Literature review reveals similar findings, emphasizing that participants make simple simplifications in the MM process, thus their simplification and structuring competencies are at low levels (Ikeda, 1997; Blum & Borromeo Ferri, 2009; Başkan, 2011; Şen Zeytun, 2013, Güç; 2015; Deniz & Yıldırım, 2018).

All groups failed at the real model stage in MP, the first activity in the study. In subsequent activities, it appears that the groups mostly passed this stage with sufficient performance. It is concluded that as participants become familiar with the MM process and gain experience, they improve in making assumptions, simplifying the situation, identifying and naming the quantities, qualities, and critical variables affecting the situation, establishing relationships between variables, finding existing knowledge, or making appropriate and accessible predictions. Other studies also report that pre-service teachers struggle to clarify the goal while solving non-routine MM problems (Kertil, 2008; Başkan, 2011; Derin & Aydın, 2020). This is because prospective teachers are not accustomed to MM problems related to daily life (Korkmaz, 2010; Başkan, 2011; Derin & Aydın, 2020).

The analysis of the reflective diaries reveals that the problems experienced stem from needing a better understanding of the subject and the need to establish relationships between related concepts. Similarly, Küçüközer (2010) and Başkan (2011) also discuss the problems arising from the inability to fully grasp the concepts and their interrelationships. Güç (2015) concludes that individuals' lack of detailed knowledge and experience about the subject causes them to struggle in determining the variables affecting the problem situation.

Mathematization competence

In this study, it was observed that pre-service science teachers and teachers had problems in all stages of MM, primarily in the transition from the real model to the mathematical model. The pre-service science teachers could not demonstrate MMC in three of the six activities (RE, PB, OZ), and the teacher groups could not create mathematical models in two (RE, PB). Many studies in the literature reveal problems in the transition phase from real model to mathematical model (Blum & Leiß, 2007; Kertil, 2008; Blum & Ferri, 2009; Borromeo Ferri, 2010; Türker et al., 2010; Frejd & Ärlebäck, 2011; Güç, 2015; Çakmak, 2019), emphasizing that the most problems in the MM process are seen in the transition from the real model to the mathematical model and in the mathematization competence (Stillman, 2006; Biccard & Wessels, 2011; Galbraith &; Gatabi & Abdolahpour, 2013; Çakmak, 2019) support the results of this study.

As seen in this study, it is concluded that the groups whose MM process experiences increased are exemplary in reaching the mathematical model after reaching the real model. Participants who determine the relevant variables and assumptions for the problem situation and reveal the relationship between them can mathematise the problem situation. It is seen that the pre-service science teachers successfully demonstrated their mathematization competencies in the last activity (YE) and the teacher groups in the last two activities (OZ, YE). In his study, Çakmak (2019) concluded that all pre-service teachers who made predictions by determining a variable performed the mathematisation competently. It is also seen in other studies in the literature that pre-service teachers who could not perform the mathematisation competence at the beginning were successful in this competence throughout the MMS (Kertil, 2008; Biccard & Wessels, 2011; Çiltaş, 2011; Ji, 2012; Güç, 2015; Kaiser & Brand, 2015). In line with the findings obtained from the observations and reflective diaries, it can be said that the reason for the inadequacy of the groups at the mathematization stage stems from the tendency to solve the problem directly.

Similarly, Başkan (2011) and Dede and Yılmaz (2016) found that students mostly estimated some numbers instead of making assumptions, while Çakmak (2019) found that pre-service teachers generally assigned a value to the variables affecting the situation. However, the problems experienced in the previous stage also affect this stage. When pre-service teachers or teachers cannot sufficiently reveal the relevant variables and the relationships between these variables, they fail in the mathematization stage (Başkan, 2011; Deniz & Yıldırım, 2018; Çakmak, 2019; Derin & Aydın, 2020).

Mathematical working competence

In evaluating mathematical working competence in this study, pre-service science teachers had no problems in one activity (KA), and teacher groups had no issues in two of the three activities where they passed the mathematization stage (OZ and KA). However, teacher groups failed in one activity (YE) after passing the mathematization stage. Generally, other studies have found that pre-service teachers and teachers successfully demonstrate mathematical working competence (Biccard & Wessels, 2011; & Kaiser & Brand, 2015; Çakmak, 2019).

Observations and examination of the reflective diaries showed that participants' failure in the mathematical work phase was due to carelessness in determining units and converting units. This result aligns with Obaidat and Malkawi's (2009) and Başkan's (2011) studies. This study also revealed that science teachers and pre-service teachers' insufficient command of logarithms, exponential functions, and similar mathematical contexts and deficiencies in mathematical operation skills caused problems in the mathematical operations phase.

Başkan (2011) found that they had gaps in subjects such as derivative, differential, and trigonometry for basic mathematics knowledge in using mathematical expressions and carrying out mathematical operations in physics courses. However, as seen in this study, using technological tools such as Excel, computer-based calculation programs, and similar technological tools helps to overcome deficiencies in the participants' mathematical operation skills. Similar studies also state that the use of technology significantly contributes to mathematical operations competence and, thus, to MMC (Stohlmann, 2012; Molina-Toro et al., 2019; Ortiz, 2020).

Interpretation competence

This study concluded that the groups who completed the mathematical study phase were exemplary in the interpretation phase. Due to the nature of science and the solid real-life context of problem situations, the familiarity of pre-service science teachers and teachers with real results can be considered the reason for this situation. In parallel with this result, Güç (2015) states that science teacher candidates and teachers who have enough experience with the real context tend to interpret the mathematical results they obtain in the real context. Although there are studies that emphasize that individuals who experience MM have difficulty in interpreting mathematical results in the real world (Maaß, 2006; Özer-Keskin, 2008; Türker et al., 2010; Bukova-Güzel, 2011; Çiltaş & Işık, 2013), the results obtained in this study coincide with the studies (Blum, 2011; Tekin-Dede & Yılmaz, 2013; Güç, 2015; Çakmak, 2019) that conclude that experience in MM is effective in questioning what the obtained results mean in real life.

Validation competence

Tekin-Dede and Yılmaz (2013) state that enabling pre-service teachers to work on MME by following the MM cycle reveals verification competence. In the literature, many studies show that the most challenging stage and competence of individuals or groups in MMS is verification (Özer-Keskin, 2008; Tipi, 2009; Bukova-Güzel & Uğurel, 2010; Başkan, 2011; Biccard & Wessels, 2011; Ji, 2012; Gatabi & Abdolahpour, 2013; Çakmak; 2019). In these studies, some reasons for the inadequacies in the verification phase are summarized as the design of the MME learning environment, the duration of the MME education, and the fact that MME is not in a structure that allows different solutions. Again, when the results of these studies are examined, it is emphasized that the reasons for the inadequacies in the verification stage are that pre-service teachers do not give this stage much importance, it is perceived as difficult and complex, it is kept short, the competence to think of different ways to solve the problem is not exhibited, and since it is challenging to create a mathematical model, there is no desire for a second model.

This study concluded that the groups who completed the mathematical study stage were exemplary in the verification stage, similar to the interpretation stage. It differs from the literature in terms of the results obtained. Güç (2015) found a partial improvement in the verification sub-competencies of pre-service teachers but stated that this development was not at the desired level. In the study, contrary to the literature, some factors come to the fore when we examine the reasons for the sufficient performance at the verification stage through the work of the groups and the opinions they conveyed in their reflective diaries. One can be said to be the environment's design by including experts in the field of activity as agents in the MM environment.

Mathematical modeling is a complex and long-term study. In this study, no time limit was set for the participants, and they were encouraged to conduct detailed research, use internet tools, and engage in long-term discussions when necessary. The fact that they were involved in a process that lasted for weeks and that there was no time limit for each activity can be considered to have turned the factors of the inadequacies in the verification

phase, which are the duration of the MM education, the lack of competence to think of different ways to solve the problem, the short duration, and the lack of enthusiasm, into positive factors.

In this study, one of the reasons for the sufficient performance of pre-service science teachers and teachers is the structure of the activities. The fact that the real-life contexts of the activities designed under the MOP are strong, video-based, and unstructured without instructions plays a role in associating mathematical results with real results.

As a result, when all activities were considered, pre-service and in-service science teachers performed best in understanding competencies. Participants had difficulty simplifying and structuring competencies, i.e., identifying variables, simplifying the problem, and identifying relevant assumptions. In this study, it was determined that all of the pre-service teachers who were able to transition to mathematical results were able to transition to real results. Considering the performances in the last two phases, it is evident that pre-service science teachers and teachers are exemplary in making the transition from mathematical results to real results. Especially considering the progress made by the groups in the last two activities (OZ, KA). It is seen that the groups had no difficulty in understanding the problem situations, but they needed help in reaching the real model. When they could reach the real model, they could reach the real results easily. It is concluded that experience in MM effectively questions what the results mean in real life.

Considering the progress of the groups in the MM steps throughout the whole process, in the first activity, Melisa, all groups remained at the understanding stage. In contrast, in the last activity, Slide, all groups could progress to the verification stage. Considering the progress in the Ozone and Slide activities, it is seen that the groups that reached the mathematization stage also passed the following stages and completed the MM cycle. It is concluded that the groups that can transition to the mathematical model can transition to mathematical results, and those that can transition to mathematical results can progress to real results.

Another significant study result is that the pre-service teachers have different modeling cycles and solution processes in different modeling situations, and their modeling cycles are individually different. This was also found by Blum and Borromeo Ferri (2009), Blum and Leiß (2007) and Matsuzaki (2011). The reason for this difference was explained by Matsuzaki (2011) as "in the MM process since each individual's real and mathematical experiences are different from each other, their approaches to the modeling situation, solution processes, and results differ from each other" (Çakmak, 2019, p. 178).

When the process is evaluated in terms of groups, it is seen that teacher groups performed better than pre-service teachers. When we consider the groups of experienced and newly graduated teachers, it is revealed that both groups exhibited the same performances in all activities.

When the subject areas are considered, the groups exhibited the lowest performances in biology activities and the highest in physics activities. It is seen that this is because what they learned in chemistry subjects did not go through a meaningful and permanent learning process. It means that they need to encounter more problem situations related to daily life. U1 and U2 stated that they had deficiencies in chemistry subjects, they had difficulty remembering the subjects, and therefore, they had problems in the MM process. T3 stated that he had difficulty remembering the chemistry knowledge he acquired in his undergraduate education because he did not use it in his professional life; P2 stated that he did not use the concepts and formulas related to the subject at the undergraduate level later on; U1 and U2 from the U group said with similar expressions that they could not remember the chemistry subjects because they did not use them and therefore had problems in reaching the real model.

In line with the findings obtained from the observations and activity forms, it is concluded that the problems encountered in demonstrating competencies in the MM process stem from the following reasons;

- Groups' tendency to solve the problem directly.
- They need more knowledge about the subject.
- Too much simplification
- Failure to establish relationships between concepts
- Identifying and delimiting variables and establishing relationships between variables
- What they experience in affective terms

It is concluded that the improvement in the mathematical modeling competencies of pre-service science teachers and teachers during the research process is due to the following factors;

- Group Work
- Structure of MM task

- Guidance
- Detailed research on the subject
- Mathematical modeling process knowledge
- Long-term work
- Technology use
- No time limit

Limitations and Recommendations

1) Since pre-service science teachers and teachers have problems in the simplification and structuring competence and mathematization stage, it can be suggested that they improve their competencies by using a atomistic approach in line with this competence and stage.

2) It is seen that MM helps to reveal and eliminate misconceptions in science education. MM can be used to identify and eliminate misconceptions.

3) It is thought that teachers and pre-service teachers should be educated about mathematical modeling. Interdisciplinary and mathematical modeling studies be introduced in mathematics and other branches through in-service training seminars, and pre-service teachers can be informed about the interdisciplinary association and mathematical modeling activities through courses to be created in pre-service teacher education.

4) Mathematical modeling studies in the field of science are almost non-existent. More mathematical modeling studies should be conducted, and academicians should be encouraged to use them in their courses.

5) When the MM studies in the field of science are examined, it is seen that the studies conducted are in the subjects of physics, while almost no studies have been conducted in biology and chemistry at all levels. Therefore, conducting mathematical modeling studies in different science subject areas may be recommended.

6) This study shows that science teachers are better than pre-service teachers in demonstrating competencies in the mathematical modeling process. Since it is predicted that introducing and experiencing modeling studies to science teachers will lead to more positive results in practical terms, it can be recommended to provide mathematical modeling training through in-service applications.

7) It may be recommended to encourage mathematical modeling studies by bringing together groups from different disciplines, such as science and mathematics, science and classroom teachers, students and teachers.

8) It may be recommended to conduct different measurement and evaluation studies to determine the mathematical modeling competencies of pre-service science teachers and teachers. Developing a mathematical modeling competencies scale may be suggested, especially for researchers who want to work quantitatively.

9) It may be recommended to offer mathematical modeling education courses at the master's and doctoral levels since providing postgraduate mathematical modeling courses in science education will increase the number of teachers who have gained the knowledge and skills of interdisciplinary work in the field of education.

Statements of Publication Ethics

The approval of ethics committee for the present study was given by Erzincan Binali Yıldırım University Social and Humanities Ethics Committee with the issue number 66653 and authors declare that the principals of research and publication ethics were followed.

Researchers' Contribution Rate

The contribution rate of each author in the manuscript is equal.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Teachers' Views on Digital Literacy and Barriers

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Abstract

This study aimed to examine teachers' views on digital literacy and its barriers. A mixed methods approach including both quantitative and qualitative data together was used. In the quantitative part, the Digital Literacy Scale developed by Ng (2012) and adapted to Turkish by Hamutoğlu et al. (2017) was used to determine the digital literacy levels of teachers. In the qualitative part, a semi-structured interview form developed by the researcher was used to collect data on digital literacy barriers. While 653 teachers participated in the quantitative part of the study, 36 teachers participated in the qualitative part. Mean values of digital literacy of the teachers who participated in the quantitative part of the study reflected a level of agreement, and no significant difference was found when the digital literacy levels of the teachers were compared with the variables of attitude, technical, cognitive and social factors and gender, department and educational status. However, a significant difference was found between the social factor and the variables of professional experience and time spent on digital platforms. When teachers' views on the barriers to digital literacy were analyzed in terms of the attitude factor, the majority of teachers emphasized the barriers of not liking and being interested in using technology and not being able to learn technology easily. When analyzed in terms of the technical factor dimension, the majority of teachers emphasized the barriers of lack of knowledge about technology and inability to use technology. When analyzed in terms of the cognitive factor, the majority of the teachers emphasized their lack of technology knowledge.

Keywords: education, educational technologies, literacy, digital literacy, digital literacy barrier

Öğretmenlerin Dijital Okuryazarlığı ve Engellerine İlişkin Görüşleri

Öz

Bu çalışmada öğretmenlerin dijital okuryazarlığı ve engellerine ilişkin görüşlerinin incelenmesi amaçlanmıştır. Araştırmada nicel ve nitel birlikte kullanıldığı için karma yöntem kullanılmıştır. Nicel kısımda öğretmenlerin dijital okuryazarlık düzeylerini belirlerken Ng (2012) tarafından geliştirilip Hamutoğlu vd. (2017) tarafından Türkçeye uyarlanan Dijital Okuryazarlık Ölçeği kullanılmıştır. Nitel kısımda dijital okuryazarlık engellerine ilişkin verilerinin toplanması için araştırmacı tarafından geliştirilen yarı yapılandırılmış görüşme formu kullanılmıştır. Nicel kısımda araştırmaya 653 öğretmen katılırken nitel kısımda 36 öğretmen katılmıştır. Araştırmanın nicel kısmına katılan öğretmenlerin dijital okuryazarlık ortalama değerleri "katılıyorum" düzeyindedir. Ayrıca öğretmenlerin dijital okuryazarlık düzeyleri; tutum, teknik, bilişsel ve sosyal faktörleri ile cinsiyet, branş, eğitim durumları değişkenleri karşılaştırıldığında anlamlı bir farklılık bulunmamıştır. Ancak, sosyal faktör ile mesleki deneyim ve dijital platformlarda geçirilen süre değişkenleri arasında anlamlı bir farklılık vardır. Öğretmenlerin dijital okuryazarlık engellerine ilişkin görüşleri; tutum faktörü açısından incelendiğinde, öğretmenlerin çoğunluğu "teknolojiyi kullanmayı sevmeme ve ilgi duymama" ile "teknolojiyi kolay öğrenememe" engelleri üzerinde durmuştur. Teknik faktörü açısından incelendiğinde, öğretmenlerin çoğunluğu "teknoloji hakkında bilgi eksikliklerinin, teknolojiyi kullanma yetersizliği yönündeki engelleri" üzerinde durmuştur. Bilişsel faktörü açısından incelendiğinde, öğretmenlerin çoğunluğu "teknoloji hakkında bilgi yetersizliği" üzerinde durmuştur

Anahtar kelimeler: eğitim, eğitim teknolojileri, okuryazarlık, dijital okuryazarlık, dijital okuryazarlık engelleri

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INTRODUCTION

Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review. Include the background information and a review of the literature in this section. You may dedicate another separate section for the literature review.

Every day a new technology is encountered. Especially with the internet, there are technological devices that exist in our daily lives enable individuals to achieve different goals and make people's lives easier. For this reason, the use of the internet and technology by individuals has increased recently (Hamutoğlu, et al., 2017). These changes that occur sometimes benefit and sometimes harm the lives of individuals. For this reason, every individual should be digitally literate. Individuals need to use technological equipment consciously within this framework. At this point, teachers who raise the young generations of the future are expected to be equipped with digital literacy (Yaman, 2019). Every aspect of our lives has changed due to technological developments. One of these changes is the concept of literacy. Traditionally, the term literacy is expressed as the ability to read and write. However, as technology and humanity develop, different types of literacy have started to emerge. Today, due to the development of technology, the importance of the concept of digital literacy has increased. Therefore, it is very important to know how to use digital and technological devices such as computers or mobile phones correctly for the individual to live a healthy life. For this reason, the concepts of digital literacy and digital skills have become increasingly important and various research on these concepts have gradually increased. (Rodríguez-de-Dios, Igartua & Gonzalez Vázquez, 2016). We need to train students in digital skills because we need to educate digitally literate individuals as a means of preventing the risks, challenges, and obstacles brought by digital technologies today. Therefore, for individuals to spend their lives healthily with the rapidly developing and advancing technology today, individuals need to get used to this developing and changing technology and what it brings. Digital literacy is one of the skills brought by these developing technologies. Individuals and students can become digital literate and gain these skills only with the training and guidance of teachers.

In short, changes and transformations are inevitable in the lives of students with rapidly developing technology. As a result of this change, it is inevitable that students gain knowledge and skills and have certain characteristics. Students now blend different learning and digital life. Students are expected to develop technical, cognitive, and social skills in order to fulfil the tasks in digital environments. The effect of teachers and institutions that provide education is very important in terms of providing individuals with these characteristics and preparing them for life (Günüç, Odabaşı & Kuzu, 2013). Being an individual who can access, analyze, understand, interpret information and use technology effectively are some of the competencies required for literacy. In order to achieve all these competencies, one should be a good digital literate. In our digital age, the process of education and training has a very important effect on the progress of societies. For this reason, making people become digitally literate means encouraging creativity, training them to see things from new perspectives, giving them a voice, and demonstrating how to deal with difficult situations. This development is ensured only by the educators who carry out the education of the young generation that holds the future in their hands and in the hands of educational institutions. According to Ministry of Education Teacher Qualifications Book (2017), in order for teachers to be able to use technology in the best way and apply it in their profession, it was emphasized that they should have digital competences. Therefore, training plans the aim is to raise individuals with digital literacy skills. All in order to achieve these, many studies have been carried out on teacher training (Arslan, 2019).

In the literature, there are many studies on digital literacy. When these studies are examined, it is seen that there are many studies on the digital literacy of teachers or students. Competences were discussed and suggestions were made for improvement. The majority of research on this area has been conducted with students or teachers or with a specific group of students or prospective teachers' department as case studies. Unlike previous studies, this study was conducted all across Turkey.

Digital Literacy

Today, such rapid developments in communication and information technologies have led to significant changes in individual and social life. These changes have led to the emergence of behavioral habits and patterns in different ways. All individuals in society exhibit behaviors specific to this new lifestyle as a requirement of today's age and try to live in today's world. The contemporary world now has unprecedentedly equal and open

mass information-sharing opportunities (Chatfield, 2013). Such developments in technologies have led to the proliferation of literacy concepts and types, and have led to the emergence of new literacy concepts that complement each other. One of the most important of these concepts is the concept of digital literacy.

The concept of digital literacy has evolved and changed over the years and today this concept is still expressed in different ways by many academics (Bawden, 2008; Martin, 2008). In the early days, the concept of digital literacy was to have instrumental hardware and software knowledge. If an individual knew how to use a computer, he was considered digitally literate (Bawden, 2001). Gilster (1997), who first introduced the concept of digital literacy, defined digital literacy as the ability to understand, evaluate, integrate and use messages from different electronic sources. Digital literacy is defined by Martin (2005) as attitude, awareness, and the ability to manage, evaluate, analyze, and combine digital tools effectively. In addition, it is expressed as a combination of behaviors and skills such as creating new information by synthesizing digital resources, communicating with individuals and their environment, and reflecting constructive behaviors in social life. Eshet-Alkalai (2004), on the other hand, defines it as a combination of motor, cognitive, emotional, and social skills that are needed efficiently in digital environments by those who use devices and software in addition to using digital software or devices. According to Van Dijk (2005), it is important to have the necessary skills to evaluate, select, and reuse the content we encounter on the internet. Another researcher Wan Ng (2012) emphasized that digital literacy consists of three basic factor dimensions: technical, cognitive, and social. The technical factor of being digitally literate means having functional and technical skills. The cognitive factor of being digitally literate is related to the ability to process this information with research, critical thinking, and evaluation. The social factor of being digitally literate includes behaviors such as using appropriate and respectful communication language as in face-to-face communication, protecting the privacy and security of personal data by keeping personal information confidential enough, not disclosing more personal data than necessary, being aware of digital threats and coping with these threats.

Digital literacy, in the most general sense, is the reading and writing of digital tools by individuals. However, when the definitions are examined, it is seen that the concept of digital literacy is much more than reading and writing activities using digital products. As the common point of digital literacy definitions, the skills and knowledge of using digital products are particularly emphasized. It is emphasized that the information is synthesized by the individual with digital literacy skills and the basis for the creation of new ideas and opinions is formed. In addition, the sociological and emotional dimension of digital literacy shows that the concept of digital literacy is a way of life (Öztürk, 2020). As can be understood from all these researches, digital literacy includes awareness, attitudes, and abilities for people to identify, access, and use digital tools effectively, as well as integrating, managing, analyzing, synthesizing information, creating new information, evaluating, enabling the sociality of the individual with the society, and communicating with the environment and society.

Digital Literacy Barriers

The world is in continuous development and transformation. Societies have changed along with it, and significant development differences have emerged day by day. While trying to reduce these development differences, the differences in technologies such as the internet, mobile phones, and computers have deepened and led to the digital divide. The digital divide, which refers to the differences between communities in the possession and utilization of information and communication technologies (ICT), has been perceived as an important problem to be overcome due to its negative effects. Today, societies with high levels of education and development use ICT intensively in all areas of life. On the other hand, societies with low levels of education and income cannot benefit from these technologies sufficiently. The basis of this situation is the digital divide and digital poverty (Kalaycı, 2013). It is a fact that a large number of individuals are still not digitally literate today. Certain factors prevent individuals from being digitally literacy. These factors are called digital literacy barriers (Semerci & Semerci, 2021).

The progress in the field of ICT has led to the expansion of traditional education and training techniques in recent years. First of all, the most important change has occurred in educational institutions, including the education of young people, their preparation for life, and the teaching of skills. To keep pace with these change, education needs to be equipped with certain skills, including the introduction of Internet technologies in education, qualitatively modernizing education, and developing a global information system to the advanced standards of modern society (Ling et al., 2020). However, there are certain barriers to the acquisition of these skills. The digital divide is at the forefront of these barriers. The digital divide arises from the fact that societies do not have the same opportunities to use ICT in the same way due to reasons such as lack of hardware or infrastructure, and lack of technical knowledge and skills. The digital divide is the differences between individuals, businesses, and geographical regions at different socioeconomic levels in terms of ICT internet usage and access opportunities

(Organisation for Economic Co-Operation and Development, 2001). In short, due to different cultural, geographical, economic, and social barriers, not all societies can benefit from developing technologies to the same extent. In other words, there is inequality in terms of having and utilizing the opportunities of developing technologies. According to Hargittai (2003), the digital divide is defined as the gap between those who have access to digital technologies and those who do not, or those who have the technology to use digital technologies and those who do not. He emphasized digital inequality as an inequality between segments of the population due to differences in various dimensions of technology access and use.

Another barrier resulting from the digital divide is digital poverty. The concept of digital poverty emphasizes minimum levels of ICT use, consumption and access. Barrantes (2007a), also identified the causes of digital poverty in his study. He stated that the lack of connection access, which is one of the ICT features, lack of demand, individuals with insufficient income and lack of use due to barriers such as age. In Figure 1, individual digital poverty levels prepared by Barrantes (2007b) are shown below.

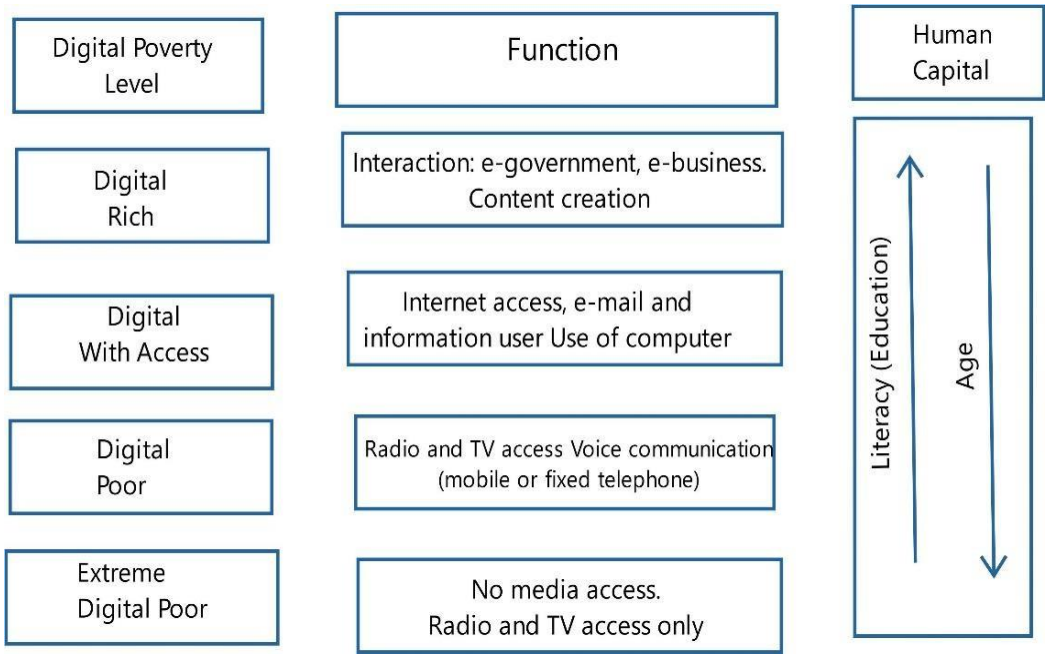

Figure 1. *Individual levels of digital poverty*

Depending on many factors, societies make minimum or no use of information and communication technologies. The emergence of digital poverty cannot be attributed only to income level. Along with the income level, it depends on factors such as insufficient and incomplete ICT infrastructure, lack of access to ICT products, lack of sufficient skills, knowledge, education and literacy to use ICT. As can be seen in the figure, digital poverty levels are shown. The digitally rich group utilizes all the possibilities of ICT and uses the Internet at every stage of life. While mobile or fixed telephone users are characterized as digital poor, individuals with only radio and TV usage are grouped as extreme digital poor. It is also observed that the increase in education level increases digital wealth, while the increase in age level increases digital poverty. In short, while the digital divide deals with inequalities in an individual's access to and use of ICT, digital poverty focuses on the access and use of information and communication technologies at the minimum level. According to another researcher Salinasa (2003), the digital divide is not only about people's access to computers and technology but also about certain factors related to people themselves. These factors are access to technology, hardware and software, individuals' ability to use technology, and individuals' interest, desire and attitudes towards technology.

When it comes to technology, the world is very different from how we lived in the past. New developments and inventions are happening every day. These developments change people's lives and the paths we follow. Education, like every field, is affected by this change. Through digital technologies such as video, internet, wireless ICT, education has changed teaching and learning processes and methods (Hooft, 2006). Many societies have experienced serious change towards the integration of new technologies into learning and have started to explore the digital advantage. The widespread use of ICT in more technologically advanced societies has already had a positive impact on many schools worldwide. Teachers and students are using these technologies to maximize ICT learning. From this perspective, ICT is an essential component of digital literacy skills (Garland, 2006). However,

not all societies succeed in developing digital literacy skills. There are certain factors and conditions that hinder ICT integration related to the acquisition of digital literacy skills (Brush & Hew 2007; Ertmer, 1999).

Analyzing these barriers, Hew and Brush (2007) found that the most frequently cited barriers to technology integration in schools in their study were (a) lack of or limited resources, (b) the organization (lack of vision or inconsistent views and leadership), (c) attitudes and beliefs, and (d) lack of or limited knowledge and skills. In addition to these factors, Ertmer (1999) categorizes barriers as first-order (organizational) or second-order (personal). First-order barriers are barriers at the organizational level, i.e. barriers related to technology integration. That is inadequate access to time, financial and human resources to technologies as well as inadequate resources for planning, cooperation, teamwork and reflection on teaching practices are among the first-order barriers (Ertmer, 1999). These are often district and school-level factors that involve inadequate or lack of access. They are barrier conditions such as access to technology resources, access, and technical support (Miranda & Russell, 2011). In addition, among the first barriers, school managers do not have the competence and the attitude to allow them to use the available resources effectively in case they do not have the knowledge or experience. As a result, inefficient use of both financial and human capital are negative conditions such as inadequate expenditures for digital technology equipment for school expenditures and insufficient training for teachers (Fullan, 2010; as cited in Hosseini, 2018). When analyzed from these perspectives, it is seen that the inability to gain digital literacy skills within the educational stages is influenced by the level of the digital divide in societies. Second-order barriers are personal barriers and include beliefs and attitudes about technology (Ertmer, 1999). Another second-order barrier to the acquisition of digital literacy skills in education is the inability of teachers and students to effectively integrate ICT into education. The reason for the lack of knowledge and skills to integrate these technologies is the inability to use technologies in educational practices (Hew & Brush, 2007). Second-order barriers can be associated with digital poverty in terms of being negative factors and conditions related to personal, beliefs and attitudes.

Purpose of the Study

According to Martin (2005), digital literacy is the ability of individuals to use digital tools and opportunities; identify, access, manage, and appropriately adapt digital resources, evaluation, analysis and synthesize, structure new knowledge, create media expressions and communicate with others, constructive social behavior in the context of private life situations. It is defined as the awareness, attitude, and ability to take action and reflect on this process. Digital literacy is defined as the ability to use a digital device or It should not be expressed in a limited framework as using software. Digital literacy is the cognitive necessary for individuals to work effectively in the digital environment, and complex, emotional, and sociological skills (Eshet, 2004). So technological tools not only cover the process of using the services offered to us, but also It include many processes such as analysis, synthesis, adaptation, and evaluation with the appropriate use of tools. To prepare the individual for the future, it can be said that teachers are at the forefront in terms of providing digital literacy skills to new generations. Therefore, examining the knowledge and skill levels of teachers about digital literacy and evaluating their views on barriers, is important at the point of digital literacy skills desired to be acquired by individuals are in operation. This research, is aimed to evaluate teachers' views on digital literacy and barriers. In this direction, the following sub-objectives were analyzed in terms of gender, education level, department, professional experience and time spent on digital platforms.

Research Questions

1. What are the opinions of teachers about the attitude sub-dimension related to digital literacy?
2. What are teachers' views on their technical skills related to digital literacy?
3. What are teachers' views on the cognitive dimension of digital literacy?
4. What are teachers' views on the social dimension of digital literacy?
5. What are teachers' views on the barriers related to digital literacy (attitude, technical, cognitive, managers' perspective and social domain)?

METHOD

Research Design

A mixed method was used in this research. The mixed method is "a research method based on collecting, analyzing and interpreting qualitative and quantitative data together to provide a better understanding of the research problem in a research process" (Leech & Onwuegbuzie, 2007). In this study, a sequential explanatory design was used. In this design, quantitative data are collected and analyzed first, and then qualitative data are collected and analyzed. Finally, the method is integrated into the findings and interpretation section (Creswell, 2003; as cited in Elaldı, 2013).

Population and Sample

Participants in the study consisted of teachers working in public or private schools across Turkey in the 2020- 2021 academic year. A total of 653 teachers, 455 women and 198 men, participated in the research, which was conducted voluntarily. In the quantitative dimension of the study, the convenient sampling method was used. "Convenient sampling is the sampling that results from the researcher's preference of the sample from easily accessible and applicable units due to the limitations that exist in terms of time, money and labor force for the researcher to select groups that can be easily applied" (Büyüköztürk et al. 2017).

In the qualitative dimension of the research, the voluntariness of the teachers determined as participants were taken as a basis, and criterion sampling, which is one of the forms of purposeful sampling, was used. Purposive sampling is a sampling that allows in-depth examination and study of situations that are thought to have rich information and data. In studies using criterion sampling, observation units consist of people, events, or situations with certain qualities (Büyüköztürk et al., 2018). The criteria were the willingness and volunteer status of the teachers, and the data of the teachers to be included in the qualitative study were paid attention to be different. The demographic characteristics of the teachers who participated in the research are given in Table 1.

Table 1. Demographic Characteristics of Teachers

Gender	N	Education Level	N	Department	N	Experience	N	Time Spent	N
Male	455	Undergraduate	575	Preschool	166	1-5	247	1-2	175
Female	198	Postgraduate	78	Class Teacher	136	6-10	97	3-4	312
				Maths	55	11-15	103	5-6	121
				Science	28	16+	206	7+	45
				Turkish	79				
				Social	32				
				English	39				
				Other	118				
Total	653								

Data Collection and Data Tool

In the quantitative part of the study, the Digital Literacy Scale developed by Ng (2012) was used, and in the qualitative part of the study, a semi-structured interview form on Digital Literacy Barriers developed by the researcher was used. The scale consists of 4 factors (attitude, cognitive, technical, and social) and 17 items. The scale validity and reliability study by Hamutoğlu et. al. (2017). Quantitative data were collected from teachers online via Google Form and the Digital Literacy Scale questionnaire, which was prepared due to the restrictions due to the COVID-19 pandemic in 2020-2021. Qualitative data were applied in a semi-structured interview form. Some of the interview forms were collected face-to-face by hand. Some of them were collected online from the internet due to the restrictions due to the Covid-19 pandemic in 2020-2021.

Research Ethics

All ethical procedures were completed in this study. Ethical permission for the research was approved by Bartın University Ethics Committee. The ethics committee document number is 2020-SBB-0190.

Analyzing the Data

Before analyzing the collected data, all surveys were numbered from 1 to 653. Afterwards, the data collected by looking at the sorted data were transferred with the electronic spreadsheet program. SPSS 22.0 software was used to evaluate the data collected in the research. Arithmetic averages were calculated to determine the factors of the digital literacy levels scale (attitude, technical, informatics, social). In the research, descriptive statistics (frequency, percentage, mean, SD), independent groups t-tests and one-way analysis of variance

(ANOVA) from parametric tests were used to examine the relationships between variables. The t-test was applied to determine whether teachers' perceptions of digital literacy competence showed a significant difference according to their gender and education level. One-way ANOVA was used to determine whether teachers' perceptions of digital literacy competence show a significant difference according to variables related to professional experience, department and time spent on digital platforms per day. The data obtained through the interview form collected in the qualitative part of the study were analyzed by descriptive analysis method using NVivo10 software and tables, figures and graphs were created. With this analysis method, the data collected are classified and explained by looking at the sub-dimensions. Teachers who participated in the qualitative part of the research were given codes up to T1, T2,……, T35, T36. In descriptive analysis, direct quotations are included to show the clear expressions of the interviewees participating in the study. The inclusion of direct quotations benefits the reliability of the qualitative study. As a result of descriptive analysis, raw data are processed, classified, and coded and results are reached with the interpretation of the researcher (Yıldırım & Şimşek, 2016). The questions in the interview form used in the research represent the factors in the sub-dimensions of the scale.

FINDINGS

Table 2. Significant Differences According to Demographic Characteristics of Teachers

	Attitude	**Technical**	**Cognitive**	**Social**
Gender	t651 =0,71; p>0,05	t651 =-1,14; p>0,05	t651 =0,21; p>0,05	t651 =-1,56; p>0,05
Education Level	t651 =0,30; p>0,05	t651 =-0,24; p>0,05	t651 =-0,46; p>0,05	t651 =-0,10; p>0,05
Department	F(3,649)= 0,62; p>0,05	F(3,649)= 1,85; p>0,05	F(3,649)= 0,99; p>0,05	F(7,645) =0,94; p>0,05
Experience	F(7,645) =1,01; p>0,05	F(7,645) =0,37; p>0,05	F(7,645) =1,71; p>0,05	F(3,649) =2,67; *p<0,05
Time Spent	F(3,649) =1,86; p>0,05	F(3,649) =2,43; p>0,05	F(3,649) =1,40; p>0,05	F(3,649) =3,66; *p<0,05

*p<0,05

There is no significant difference in the attitude, technical, cognitive and social dimensions of digital literacy according to gender, educational level and department. Furthermore, there is no significant difference in the attitude, technical and cognitive dimensions of digital literacy according to the experience and time spent, while a significant difference was found in the social dimension.

According to the results of the Least Significant Difference (LSD) test conducted to find out between which groups the differences between the professional experience groups of the teachers, it is seen that between 1-5 years and 6-10 years of experience in favor of 1-5 years group and between 1-5 years and 16+ years of experience in favor of 1-5 years group are more positive. At this point, the eta square (η^2) value was found to be 0.01. The social sub-variable of digital literacy explains approximately 1% of the total variance in the professional experience variable. This result shows that the effect value is small.

According to the results of Least Significant Difference (LSD) test conducted to find out between which groups the differences are, it is seen that the time spent by teachers on digital platforms in a day is more positive between 1-2 hours and 3-4 hours group in favor of 3-4 hours group and between 1-2 hours and 7+ hours group in favour of 7+ hours group. At this point, the eta square (η^2) value was found to be 0.02. The social sub-dimension of digital literacy explains approximately 2% of the total variance in the variable of time spent on digital platforms in a day. This result shows that the effect value is at a small level.

Findings on Digital Literacy Barriers

The interview form on digital literacy barriers developed by the researcher was based on the reviewed literatures and the sub-dimensions of the digital literacy scale applied in the quantitative part of the research; the sub-dimensions related to these barriers are shown in the figure below.

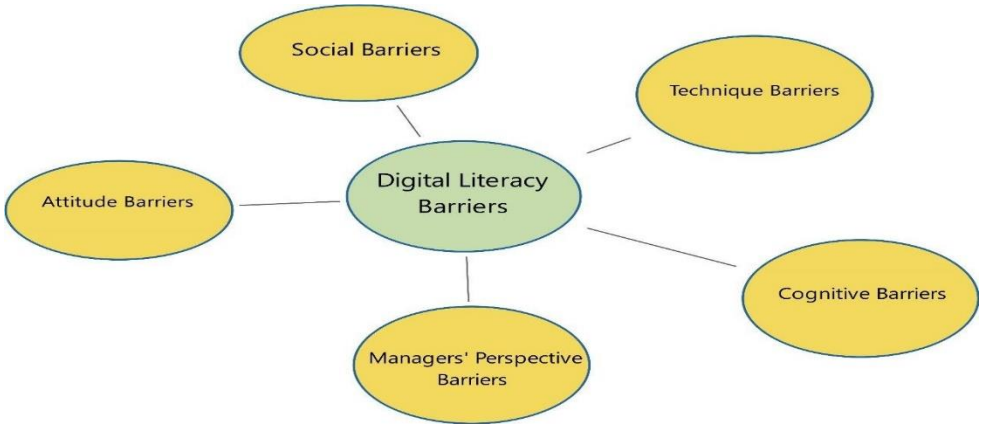

Figure 2. *Sub-dimensions of digital literacy barriers*

Digital literacy barriers consist of five sub-dimensions: attitude, technical, cognitive, manager perspective and social barriers. In this section, the views of 36 teachers on these sub-dimensions are given. Teachers who participated in the qualitative part of the research were given codes up to T1, T2……, T35, T36.

Attitude Barriers

The results of the analyses of the opinions and expressions of the teachers participating in the research on the attitude sub-dimension of digital literacy barriers are showed below.

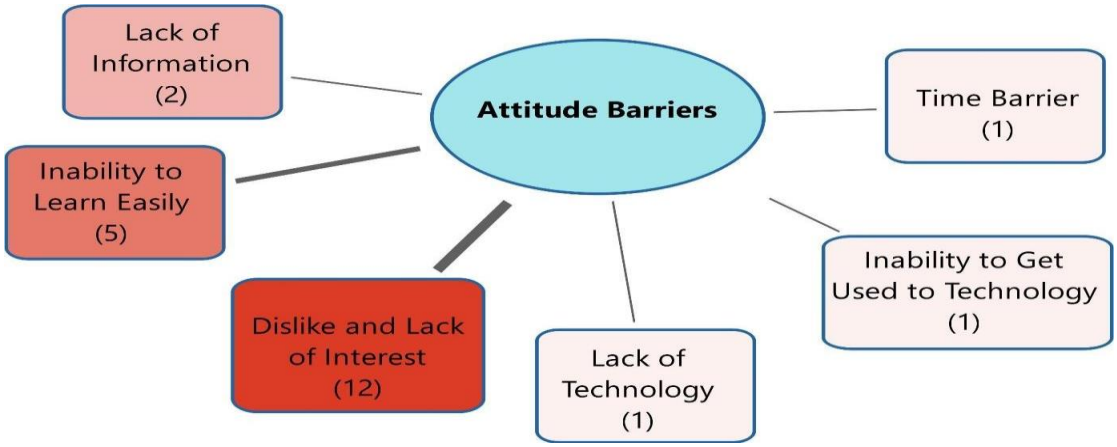

Figure 3. *Attitude barriers codes*

(**Note:** In the attitude sub-dimension disabilities, 4 people with no answer and 10 people with the statement "I have no disability" are not included in the figure).

The main codes that emerged from the opinions and statements of the teachers in the attitude sub-dimension of digital literacy barriers were grouped under 6 main headings: dislike and lack of interest in using, inability to learn easily, lack of technology, inability to get used to technology, lack of knowledge and time barrier.

T6, T8, T11, T13, T14, T16, T17, T23, T27, T30, T33 and T6 coded teachers stated that they did not like and were not interested in technology. T11; " I don't want to go into the details of the work, except to find and learn what I need.", T14; "I don't like to use it, but I have to", T16; "I don't have much interest in technology", T27; "I don't like it too much, I use it when I need it", they stated that not liking and not being interested in technology is an important barrier in the attitude sub-dimension in terms of digital literacy barriers. T1, T5, T10, T12 and T20 coded teachers stated that they could not learn technology easily. T1; "I generally like technology but I cannot learn it easily.", T5; "I use technology, but I get help from time to time. I have no difficulty in learning because technology is now both a need and a necessity. Education is necessary in every moment of life. I try my best to make it a life process.", T20; "We cannot learn very easily" and stated that they had difficulty in learning technology and that this was an important barrier in the attitude sub-dimension in terms of digital literacy barriers. T9 and T21 coded teachers stated that they lacked knowledge about technology and this was an important barrier in the attitude sub-dimension in terms of digital literacy barriers. T3 stated that she likes technology and uses it effectively, but she also stated that the lack of technology is an important barrier in terms of digital literacy barriers in the attitude sub-dimension. T3; "I like to learn and try new digital platforms, I like to do different studies

and I learn programs easily. For example, I can write a story with Adobe Photoshop program and I am trying to make an animation of it. However, there is not enough technological equipment in terms of discovering new programs and education, which forces me to produce new ones, and I think it would be better if there were a few examples." T32 coded teacher stated that he could not adapt to new things and that he could not adapt to technology in any way, which is an important barrier in the attitude sub-dimension in terms of digital literacy barriers. T32 expressed his opinion as follows; " I have a hard time adapting to new things, I had a great difficulty in sharing the applications in the Zoom in the upload part of the song". T24 stated that he wanted to improve himself in this subject but could not spare time and that this was an important barrier in the attitude sub-dimension in terms of digital literacy barriers. T24; " Time barrier due to my job, other than that, an area I want to improve myself"

Table 3. Answers According to Demographic Characteristics of Digital Literacy Disability Attitude Barriers

Digital Literacy Barrier	Gender		Experience (Year)			Time Spent (Hour)		
Attitude Barriers	Male	Female	1-5	6-10	16+	1-2	3-4	5-6
Lack of Information	1	1	0	1	1	0	1	1
Inability to Learn Easily	0	5	1	0	4	2	2	1
Dislike and Lack of Interest	5	7	1	0	11	3	6	3
Lack of Technology	0	1	1	0	0	0	0	1
Inability to Get Used to Technology	0	1	0	1	0	0	1	0
Time Barrier	0	1	0	1	0	0	1	0
Total	6	16	3	3	16	5	1	6

When the barriers of the attitude sub-dimension of digital literacy barriers were examined, the majority of the teachers participating in the qualitative research emphasized the expressions of not liking and not being interested in using technology, not being able to learn technology easily, and 10 teachers stated that they did not have any barriers in the attitude sub-dimension of digital literacy barriers, so they were not included in the attitude sub- dimension barriers. When the table is analyzed in terms of gender, 5 of the female teachers expressed the barrier of not being able to learn technology easily, while none of the male teachers mentioned such a barrier. When the table was analyzed in terms of years of professional experience, the majority of teachers with 16 + years of professional experience expressed the barriers of not liking and not being interested in using technology and not being able to learn technology easily, while very few of the teachers with 1-5 and 6-10 years of professional experience expressed these barriers. The majority of teachers who spent 1-2 and 3-4 hours on digital platforms in a day expressed the barriers of not liking and not being interested in using technology, which are among the barriers of the attitude sub-dimension of digital literacy barriers.

Technical Barriers

The results of the analyses of the opinions and expressions of the teachers participating in the research on the technical sub-dimension of digital literacy barriers with the NVivo software are shown below.

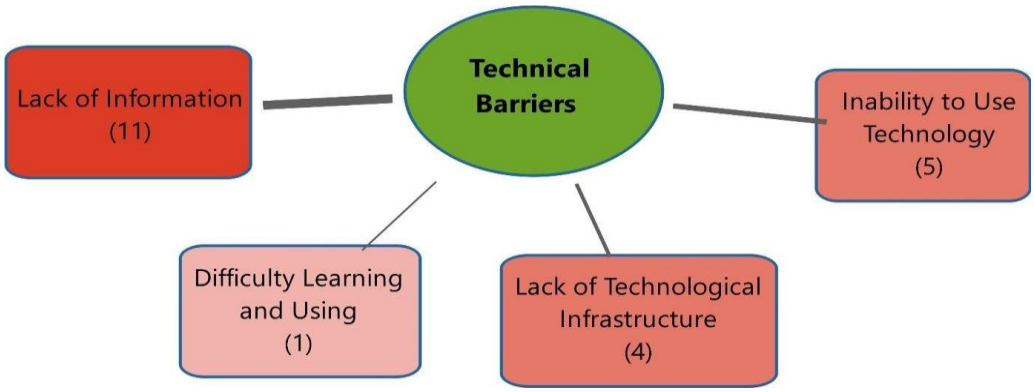

Figure 4. *Technical barriers codes*

(**Note:** In the technical sub-dimension barriers, 8 people who did not answer and 7 people who said they had no barriers are not included in the figure)

The main codes that emerged from the opinions and statements of the teachers in the technical sub-dimension of digital literacy barriers were grouped under 4 main headings: lack of knowledge about technology, inadequacy in using technology, lack of technological infrastructure, and difficulty in learning and using technology.

T3, T8, T10, T11, T12, T22, T26, T30, T32 and T33 coded teachers stated that they would create barriers in the technical sub-dimension of digital literacy barriers because they lacked knowledge about technology. T3; "I do not have enough knowledge about the computer freezing and renewing itself. I cannot correct the ready-made programs when they give errors. I do not have a problem as long as there is no barrier in a normal functioning", T10; "Lack of infrastructure and technical knowledge", T11; "Although I do not know all the technical issues, I do research in order to use what I need", T32, " You don't have much technical knowledge on issues like this, I usually try to get someone who knows the job done, I get support from the computer", T22, T26, T30 and T33 teachers stated that they had disabilities in the technical sub-dimension of digital literacy barriers due to their lack of technical knowledge about technology or incomplete and incorrect knowledge. T1, T3, T6, T16 and T20 coded teachers stated that they would create barriers in the technical sub-dimension of digital literacy barriers because they were inadequate in using technology. T1; "I am insufficient in using mobile technologies with technical skills." T3; "I don't have enough information about the computer freezing and refreshing itself. I can't fix ready-made programs when they give errors. I don't have a problem as long as it doesn't interfere with normal operation.", T6; "I cannot use digital teaching materials", T16; "I cannot solve some technical problems (drivers, package programs, etc.)" T20; "We cannot use mobile technologies much" and stated that being inadequate in using technology is a disability in the technical sub-dimension of digital literacy barriers. T13, T14, T23 and T35 coded teachers stated that the lack of technological infrastructure would be a barrier in the technical sub-dimension of digital literacy barriers. T13, T14, T23 and T35 coded teachers stated that the lack of technological and internet infrastructure in institutions is a barrier in the technical sub-dimension of digital literacy barriers. T27 coded teacher stated that having difficulty in learning and using technology would be a barrier in the technical sub-dimension of digital literacy barriers. T27 answered as "I have difficulty in using technological tools and learning programs." and stated that having difficulty in learning and using technology is a barrier in the technical sub-dimension of digital literacy barriers.

Table 4. Answers According to Demographic Characteristics of Digital Literacy Disability Technical Barriers

Digital Literacy Barrier	Gender		Experience (Years)			Time Spent (Hour)			
Technical Barriers	Male	Female	1-5	6-10	16+	1-2	3-4	5-6	7 +
Lack of Information	2	9	1	1	9	1	8	1	1
Difficulty in Learning and Using	0	1	0	0	1	0	1	0	0
Lack of Technological Infrastructure	3	1	1	0	3	1	2	1	0
Inability to Use Technology	0	5	2	0	3	2	1	2	0
Total	5	16	4	1	16	4	12	4	1

When the barriers of the technical sub-dimension of digital literacy barriers were examined, the majority of the teachers participating in the qualitative research emphasized the expressions of lack of knowledge about technology and inability to use technology. When the table is analyzed in terms of gender, 5 of the female teachers mentioned the barrier of inadequate use of technology, while none of the male teachers mentioned such a barrier. While 3 of the male teachers expressed the barrier of lack of technological infrastructure, only 1 of the female teachers expressed the barrier of lack of technological infrastructure. When the table was analyzed in terms of years of professional experience, the majority of teachers with 16+ years of professional experience mentioned the barrier of lack of knowledge about technology, while 1 person each from teachers with 1-5 and 1- 6 years of professional experience mentioned this barrier. Only 1 teacher with 16+ years of professional experience stated that they had difficulty in learning and using technology. When the table was analyzed in terms of the time spent on digital platforms in a day, 8 teachers who spent between 3-4 hours a day on digital platforms mentioned their lack of knowledge about technology, while 1 person each from teachers with 1-5, 1-6 and over 7 hours mentioned this barrier.

Cognitive Barriers

The results of the analyses of the opinions and expressions of the teachers participating in the research on the cognitive sub-dimension of digital literacy barriers with the NVivo software are shown below.

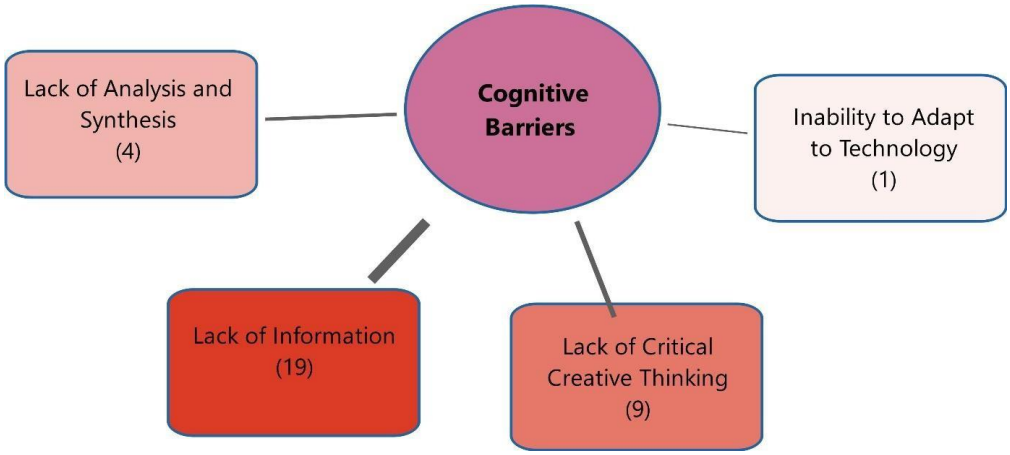

Figure 5. *Cognitive barriers codes*

(**Note:** In the cognitive sub-dimension disabilities, 5 people who did not answer and 6 people who said they had no disability are not included in the figure).

In the cognitive sub-dimension of digital literacy barriers, the main codes emerging from the opinions and expressions of the teachers were grouped under 4 main headings: lack of knowledge about technology, lack of critical and creative thinking in the use of technology, lack of analysis and synthesis in the use of technology, and inability to adapt to technology.

T1, T4, T6, T8, T9, T10, T11, T12, T14, T17, T19, T20, T21, T23, T24, T30, T31, T33 and T36 coded teachers stated that their lack of knowledge about technology would be an barrier in the cognitive sub-dimension of digital literacy barriers.", T14; "Information is incomplete and incorrect", T31; "Insufficient information and critical thinking inadequacy evaluation" and other teachers stated that they had barriers in the cognitive sub-dimension of digital literacy barriers because they had incomplete information about technology or they knew incorrectly. T7, T8, T22, T26, T30, T31, T33 and T35 coded teachers stated that the lack of critical and creative thinking in the use of technology would be a barrier in the cognitive sub-dimension of digital literacy barriers. T8, T13, T30 and T33 coded teachers stated that the lack of analyzing and synthesizing in the use of technology would be a barrier in the cognitive sub-dimension of digital literacy barriers. T5 coded teacher stated that not being able to adapt to technology would be a barrier in the cognitive sub-dimension of digital literacy barriers. T5; "In general, I cannot adapt to new activities quickly while using my problem." and stated that not being able to adapt to technology is a barrier in the cognitive sub-dimension of digital literacy barriers. It is also seen in the figure above that T8, T30, T31 and T33 coded teachers gave answers by emphasizing more than one barrier in the cognitive sub-dimension of digital literacy barriers.

Table 6. Answers According to Demographic Characteristics of Digital Literacy Disability Cognitive Barriers

Digital Literacy Barrier	Gender		Experience (Year)			Time Spent (Hour)			
Cognitive Barriers	Male	Female	1-5	6-10	16+	1-2	3-4	5-6	7 +
Lack of Analysis and Synthesis	1	3	0	0	4	0	4	0	0
Lack of Information	6	13	3	3	13	5	9	5	0
Lack of Critical Creative Thinking	2	7	1	1	7	1	6	1	1
Failure to Adapt to Technology	0	1	0	0	1	0	0	1	0
Total	9	24	4	4	25	6	19	7	1

When the cognitive sub-dimension barriers of digital literacy barriers were examined, the majority of the teachers who participated in the qualitative research emphasized the lack of knowledge about technology. 7 of the teachers with 16 years of professional experience or more emphasized the lack of critical and creative thinking in the use of technology, while only 1 of the teachers with 1-5 and 6-10 years of professional experience emphasized this barrier.

Social Barriers

The results of the analyses of the opinions and expressions of the teachers participating in the research on the social sub-dimension of digital literacy barriers with the NVivo software are shown below.

Figure 6. *Social barriers codes*

(**Note:** In the social sub-dimension barriers, 3 people who did not answer and 2 people who said they had no barriers are not included in the figure).

The main codes that emerged from the opinions and statements of the teachers in the social sub-dimension of digital literacy barriers were grouped under 7 main headings: economic barriers due to personal budgets, misuse and misuse of technology, not using and disliking technology socially, information pollution due to unnecessary information on the internet, political barriers due to the current political administration, distrust of the internet and inability to allocate time.

T4, T5, T8, T17, T21, T22, T23, T24, T25, T26, T30, T33 and T34 coded teachers stated that economic barrier due to personal budgets would be a barrier in the social sub-dimension of digital literacy barriers. T4; "Sometimes I find articles (education and social politics) but most of them are paid.", T5; "Budget and not participating in activities", T24; "Budget and access to security/personal data over the internet." and other teachers stated that economic barrier due to personal budgets is a barrier in the social sub-dimension of digital literacy barriers. T1, T6, S7, T13, T16, T19 and T36 coded teachers stated that the wrong and incorrect use of technology would create barriers in the social sub-dimension of digital literacy barriers. T1; "It is used more for entertainment purposes instead of conscious consumption." T6; " Writing comments without information ", T7; "Commenting on political issues without information", T16; "Very superficial information. False news. Insulting posts.", T16; "Very superficial information. False news.", T6; "Commenting on political issues without information", T7; "Commenting on political issues without information", T16; "Very superficial information. Teachers T5, T14, T28, T29, T31 and T35 stated that not using and liking technology socially would be a barrier in the social sub-dimension of digital literacy barriers. T14; "The virtual world feels cold.", T28; "In ability to use internet-based activities" and other teachers stated that not using and liking technology socially would be a barrier in the social sub-dimension of digital literacy barriers. T2, T3, T11, T16, T18 and T36 coded teachers stated that information pollution due to unnecessary information on the internet would cause barriers in the social sub-dimension of digital literacy barriers. T2; "Information pollution on the internet can cause difficulties in digital literacy.", T3; " Even people who do not know the social field can make all kinds of comments. I encounter unnecessary and unconscious comments while researching something" T16; "Very superficial information. False news. Insulting posts." and other teachers stated that information pollution due to unnecessary information on the internet would create a barrier in the social sub-dimension of digital literacy barriers. T8, T30 and T33 coded teachers stated that political barriers due to the current political administration would create barriers in the social sub-dimension of digital literacy barriers. T18 and T24 teachers stated that insecurity in the internet would be a barrier in the social sub-dimension of digital literacy barriers. T24 stated that insecurity in the internet would be a barrier in the social sub-dimension of digital literacy barriers with expressions such as "Budget and security over the internet/access to personal data.". T9 and T10 coded teachers stated that not being able to allocate time due to workload or lack of time would be a barrier in the social sub-dimension of digital literacy barriers. It is also seen in the figure above that T5, T8, T16, T18, T24, T30, T33 and T36 teachers gave answers by emphasizing more than one barrier in the social sub-dimension of digital literacy barriers.

Table 7. Answers According to Demographic Characteristics of Digital Literacy Disability Social Barriers

Digital Literacy Barrier	Gender		Experience (Year)			Time Spent (Hour)			
Social Barriers	Male	Female	1-5	6-10	16+	1-2	3-4	5-6	7 +
Information Pollution	3	3	2	0	4	2	2	1	1
Economic Barrier	5	8	1	2	10	1	7	4	1
Insecurity	1	1	0	1	1	0	2	0	0
Political Barrier	0	3	0	0	3	0	3	0	0
Social Disuse and Dislike	1	5	1	1	4	1	1	4	0
Not Making Time	1	1	0	0	2	0	2	0	0
Improper and Incorrect Use	3	4	2	0	5	2	2	3	0
Total	14	25	6	4	29	6	19	12	2

When the social sub-dimension barriers of digital literacy barriers were examined, many teachers emphasized economic barriers.

Manager Barriers

The results of the analyses of the opinions and expressions of the teachers participating in the research on the manager sub-dimension of digital literacy barriers with the NVivo software are shown below.

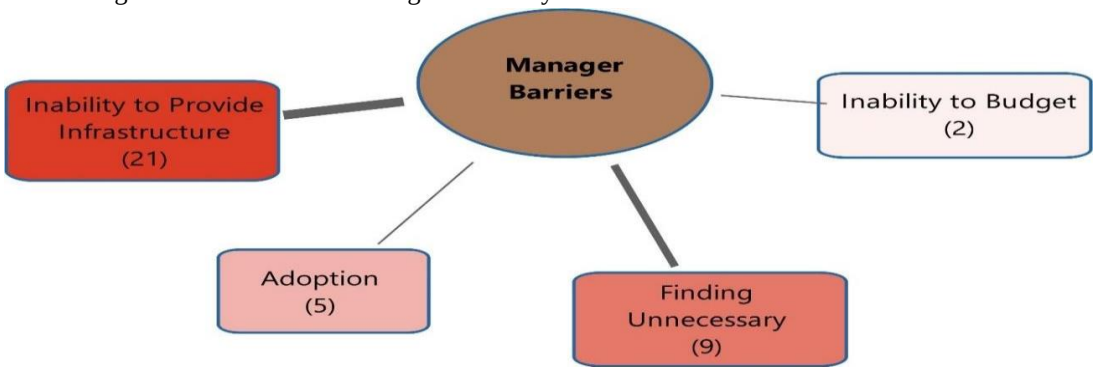

Figure 7. *Manager barriers codes*

(**Note:** 4 people who said that there is no barrier in the manager sub-dimension barriers are not included in the figure)

The main codes that emerged from the opinions and expressions of the teachers in the manager sub-dimension of digital literacy barriers were categorized under 4 main headings: inability to provide infrastructure, finding it unnecessary, not adopting it, and inability to provide budget.

T1, T2, T6, T9, T10, T11, T12, T13, T17, T18, T20, T21, T23, T25, T26, T28, T29, T31, T32, T34 and T36 coded teachers stated that managers' not providing technological infrastructure would be a barrier in the manager sub-dimension of digital literacy barriers. T2; "It cannot be unnecessary, but the lack of technological infrastructure may cause problems", T11; "Not creating resources and not believing in the necessity", and other teachers stated that the managers' failure or inability to provide technological infrastructure would create barriers in the manager sub-dimension of digital literacy barriers. T3, T4, T7, T11, T14, T16, T19, T22 and T35 coded teachers stated that managers' seeing technology as unnecessary would create barriers in the manager sub-dimension of digital literacy barriers. T3; "They want something more concrete than digital, they find digital platforms unnecessary", T4; " I think they should especially adopt the platform because it is more convenient and practical in terms of use.", T11; "Not creating resources and not believing in its necessity", T16; "They see it as a waste of time." With these expressions, other teachers stated that managers' seeing technology as unnecessary would be a barrier in the manager sub-dimension of digital literacy barriers. T4, T8, T30, T32 and T33 coded teachers stated that the managers' inability to adopt technology and their inability to adapt to it would constitute a barrier in the manager sub-dimension of digital literacy barriers. T32; "Those in the primary education organization where I work do not support these issues, they do not support them, they give importance to success-oriented things and support them in the following process.", and other teachers have stated that the inability of managers to adopt technology will be a barrier in the manager sub-dimension of digital literacy barriers. T18 and T32 coded teachers stated that the inability of managers to provide budget for technology would be a barrier in the manager sub-dimension of digital literacy barriers. It is also seen in the figure above that T4, T11, T18 and T32 teachers gave answers by emphasizing more than one barrier in the manager sub-dimension of digital literacy barriers.

Table 8. Answers According to Demographic Characteristics of Digital Literacy Disability Manager Barriers

Digital Literacy Barrier	Gender		Experience (Year)			Time Spent (Hour)			
Manager Barriers	Male	Female	1-5	6-10	16+	1-2	3-4	5-6	7 +
Failure to Provide Infrastructure	9	12	2	3	16	5	8	6	2
Non-adoption	1	4	1	1	3	0	5	0	0
Failure to Provide Budget	1	1	0	1	1	0	2	0	0
Finding Unnecessary	3	6	3	0	6	1	4	4	0
Total	14	23	6	5	26	6	19	10	2

When the barriers of the manager sub-dimension of digital literacy barriers were analyzed, the majority of the teachers emphasized that the managers did not provide technological infrastructure.

DISCUSSION & CONCLUSION

According to the results of the quantitative part of the research; teachers' digital literacy levels were analyzed using the "Digital Literacy Scale". Mean values of digital literacy of the teachers who participated in the quantitative part of the study reflected a level of agreement. Similarly, Kozan and Özek (2019), Yaman (2019), Arslan (2019), Öçal (2017), Korkmaz (2020), Cote and Milliner (2018), Waluyo (2019) et al. studies show similarities. No difference was found when teachers' digital literacy levels attitude, technical, cognitive and social factors were compared with the gender variable. This finding is similar to the results of Kozan and Özek (2019), Ocak and Karakuş (2019), Yaman (2019), Arslan (2019). Different situations were also found in similar field studies. In the studies of Çetin (2016), Özerbaş and Kuralbayeva (2018), Yeşildal (2018), it was determined that the Digital Literacy levels of male teachers were higher than female teachers. Today, developing technology and changing studies on digital literacy may have positively changed the digital literacy levels of female teachers, so there may be no difference in new studies.

No significant differences were found when the digital literacy levels of teachers were analyzed according to the attitude, technical, cognitive and social factors and department. Arslan (2019), Kozan (2018), Üstündağ, Güneş and Bahçivan (2017) found that numerical departments have higher digital literacy levels than other departments. Nowadays, the integration of each course with technology in the education programs of the Ministry of National Education and its association with the concept of digital literacy has positively reflected on the digital literacy levels of teachers in all departments, so there may be no difference on the basis of the department of the teachers in the new study.

While there was no significant difference between teachers' digital literacy levels, attitude, technical and cognitive factors and teachers' professional experience, there was a significant difference between teachers' professional experience and social factors. As the professional experience of teachers increases, their digital literacy levels in terms of social factors decrease. The digital literacy levels of newly appointed teachers are quite good because they are curious about the use of digital technologies, they have just graduated from university and use digital technology in every field. On the other hand, older teachers' late acquaintance with digital technology, their low use of digital technology in daily life, and the fact that they continue their education in their own way and use digital technology less in the lesson may have left their digital literacy levels behind in terms of social factor. Arslan (2019) found that junior teachers had higher social and technical digital literacy levels than senior teachers, but did not find a significant difference in terms of attitude and cognitive digital literacy levels. Similarly, Öçal (2017) found that teachers who are newer in their professional life are more competent in terms of digital literacy. In another study, Korkmaz (2020) found that digital literacy levels of classroom teachers decreased as their years of service in their profession increased.

No significant difference was found when the digital literacy levels of teachers were analyzed between attitude, technical, cognitive and social factors and educational status. This finding is similar to the findings of Arslan (2019), but different situations were encountered in similar field studies. Öçal (2017) and Korkmaz (2020) stated that digital literacy levels vary according to educational status, and that teachers with master's and doctoral degrees are more adequate in digital literacy level, and that teachers with postgraduate degrees have higher digital literacy levels than teachers with bachelor's degrees.

While there is no significant difference in the digital literacy levels of teachers in terms of attitude, technical and cognitive factors according to the time spent on digital platforms in a day, there is a significant difference in terms of social factor according to the time spent on digital platforms in a day. As the time spent on digital platforms in a day increases, digital literacy levels of teachers in terms of social factors also increase. Çetin (2016), Özerbaş and Kuralbayeva (2018), Arslan (2019), Öçal (2017) and Acar (2015) also found in their studies that

teachers' digital literacy levels increased as the time spent on computers and the internet increased. In these studies, they stated that as the time teachers spend on the computer and the internet increases in a day, their digital literacy levels are higher in terms of attitude and technique. However, Kozan (2018) concluded that the digital literacy levels of information technologies teachers did not differ according to the time they spent on the computer and the internet in a day.

In the qualitative dimension of the research, the results of the cognitive factor are remarkable. When the teachers' views on the barriers to digital literacy were analyzed in terms of the cognitive factor, the main codes that emerged were grouped under 4 main headings: lack of knowledge about technology, lack of critical and creative thinking in the use of technology, lack of analysis and synthesis in the use of technology, and in ability to adapt to technology. A great majority of the teachers participating in the qualitative research emphasized the lack of knowledge about technology. While 7 of the teachers with 16 years or more of professional experience emphasized the inability to think critically and creatively in the use of technology, only one of the teachers with 1-5 and 6-10 years of professional experience emphasized this barrier.

One of the ways for individuals to acquire and gain digital literacy skills is to identify the barriers to having digital literacy skills and to eliminate these barriers through education and training programs. Unless these barriers to digital literacy are identified, it cannot be guaranteed that teaching digital literacy skills to individuals will take more time and a positive result will be obtained (Semerci & Semerci, 2021). It is expected that the results of this thesis will be used when developing training programs.

Statements of Publication Ethics

The ethics committee report of this research was obtained from Bartın University, social and human publication ethics committee (Date: 30/09/2020; Decision no:2020-SSB-0190). All participants who took part in the study provided informed consent.

Researchers' Contribution Rate

In this study, each of the authors contributed equally to each stage. This study is based on the master's thesis written by Mert SAĞ.

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Mert SAĞ	☒	☒	☒	☒	☒	☒
Çetin SEMERCİ	☒	☒	☒	☒	☒	☒

Conflict of Interest

The authors declare that there is not conflict of interest

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Virtual Classroom Management: An Analysis of Virtual Classroom Management Dynamics and Strategies of Teachers

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Abstract

Digital learning platforms and virtual classrooms are growing more widespread, so virtual classroom management is gaining more importance to ensure student engagement, involvement, and achievements in an online learning environment. The research examines virtual classroom management dynamics and explores the factors that render teachers' virtual classroom management practices, strategies, and expectations in this regard. The study is phenomenological research, and data was collected through open-ended questions with 22 lower secondary school teachers working in Istanbul. The findings were gathered under four themes: virtual classroom management process, professional development, opportunities and challenges of virtual classrooms, and solutions to virtual classroom management problems. These results highlight the significance of engagement and motivation toward virtual classrooms and propound teachers' digital competencies and classroom management skills as two fundamental factors in fostering students' engagement in virtual classrooms.

Keywords: virtual classroom, classroom management, online learning

Sanal Sınıf Yönetimi: Öğretmenlerin Sanal Sınıf Yönetimi Dinamikleri ve Stratejilerinin İncelenmesi

Öz

Her geçen gün dijital öğrenme platformları ve sanal sınıflar daha yaygın hale gelmekte ve bu doğrultuda öğrencilerin çevrimiçi öğrenme ortamlarına dahil olmaları, derse aktif katılımları ve başarılarını artırmaya yönelik sanal sınıf yönetimi becerileri ve stratejileri daha fazla önem kazanmaktadır. Bu araştırma, sanal sınıf yönetimi dinamiklerini incelemekte ve öğretmenlerin sanal sınıf yönetimi uygulamalarını, stratejilerini ve bu konudaki beklentilerini etkileyen faktörleri araştırmaktadır. Araştırma fenomenolojik desende olup, veriler İstanbul'da görev yapan 22 ortaokul öğretmeninden açık uçlu sorular aracılığıyla elde edilmiştir. Bulgular dört tema altında toplanmıştır: sanal sınıf yönetimi süreci, mesleki gelişim, sanal sınıfların sunduğu fırsatlar ve zorluklar ve sanal sınıf yönetimi sorunlarına karşı çözümler. Bu sonuçlar, sanal sınıflarda etkin katılımın ve motivasyonun önemini vurgulamakta ve öğretmenlerin dijital yeterliliklerini ve sınıf yönetimi becerilerini, öğrencilerin sanal sınıflara etkin katılımını teşvik eden iki temel faktör olarak öne sürmektedir.

Anahtar kelimeler: sanal sınıf, sınıf yönetimi, çevrimiçi öğrenme

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INTRODUCTION

The World Health Organization (WHO) announced Covid-19 as a global pandemic in March 2020 (WHO, 2020), and then schools in Turkey switched to distance education. In this process, schools mostly preferred the Zoom platform since the Education Information Network (EBA), the official distance education software of the Republic of Turkish Ministry of National Education (MoNE), was insufficient for synchronous education. In time, MoNE made improvements and investments for EBA, and it even ranked first on the global scale according to its users and internet traffic in the first term of the 2020-2021 school year (MoNE, 2023a). According to the MoNE coronavirus measures, during the 2020-2021 school year, only the students from villages and sparsely populated settlements could attend five days of full-time education. Other schools were partially open, and students at all primary schools, pre-schools, and the final year of secondary and tertiary schools went to school twice a week. Parents who did not want to send their children to school for face-to-face education had the right to give written consent, and these students could continue their education through distance learning (MoNE, 2023b).

Technology, remote learning, online learning, and distance learning are not new in the world of education, and their use has increased rapidly in the 21st century. The Covid-19 process, and the emergency remote teaching have accelerated the digital transformation of education and the use of online classrooms. Higher education institutions and K-12 schools have all tried to adapt their systems. During the new normal, they quickly embraced online classroom platforms (e.g., Google Classroom, Teams, Moodle, EdMono, Blackboard) and video conferencing tools (e.g., Zoom, Google Meet, Skype). Currently, online education has emerged as a reality for everyone. Now, there are several efforts, investments, and initiatives for an ongoing digital transformation in education (Li & Lalani, 2020; Nousopoulou et al., 2023; Soykan et al., 2023) and the active use of online learning, blended learning, and virtual classes (Dos Santos, 2022; Future Learn, 2022). According to literature (Albashtawi & Al Bataineh, 2020; Can, 2020; Clark & Kwinn, 2007; Kaya, 2011; Mashhadia & Kargozarib, 2011), virtual classrooms offer various benefits for learners and teachers. The dimensions of virtual classroom management bear similarities to those of traditional classroom management, yet they differ following the diversity inherent in the digital teaching environment (Can, 2020; Brophy, 1998; Egeberg et al., 2021). Managing a virtual classroom requires a unique approach to classroom management. For this reason, it is highly considerable to recognize the online classroom environment, make sense of its processes, and specify virtual classroom management dynamics and strategies.

After the outbreak of Covid-19, we could say that there has been an increase in the number of studies on managing virtual classes (e.g., Arslan & Sumuer, 2020; Can, 2020; Cortes et al., 2022; Keshavarz et al., 2022; Karakaya et al., 2020; Sari & Nayir, 2020). In the Turkish context, there have been several studies on virtual classroom management, too. Can (2020) researched principles and practices related to virtual classroom management. Arslan and colleagues (2021) provided suggestions on how to address classroom management challenges. Similarly, Can (2020) and Ceylan (2020) focused on teacher competencies in this field. Atabay and colleagues (2023) explored the virtual classroom management processes. Virtual and traditional classrooms have distinct characteristics, resulting in different management approaches (Can, 2020). The literature suggests that the virtual classroom management process and dimensions are not yet fully established (Atabey et al., 2023), as it is a relatively new area compared to traditional classrooms. Therefore, there is a need to develop a better understanding of virtual classroom management processes. With this study, we aimed to reach the teachers who taught in the virtual classroom and experienced classroom management and to make sense of the virtual classroom management phenomenon from their perspective. It is crucial to reveal what teachers do in practice, what they care about, what their strategies are, what they find problematic, how they come up with solutions to these problems, and what their expectations for the future are. For this reason, the following research questions guided our study:

RQ1: What are the views of teachers regarding virtual classroom management?

RQ2: What are the expectations of teachers regarding virtual classroom management?

Virtual classroom

Virtual classroom extends the classroom from its four walls and allows students to attend classes wherever they want. It provides flexibility of time and place (Smedley, 2010). In online classrooms, students and teachers do not need to be at the same location. They could meet from different places at the same time (synchronous) or at different times (asynchronous) under the supervision of the teacher and use different communication tools (Can, 2020; Clark & Kwinn, 2007; Kaya, 2011; Mashhadia & Kargozarib, 2011). Virtual classrooms could offer students self-directed learning environment at their own pace and plenty of interactivity as students who are spatially and

temporally apart (Mashhadia & Kargozarib, 2011). These features could increase students' satisfaction and lower their stress (Arkorful & Abaidoo, 2015). Besides, virtual classrooms could decrease the cost of education. They provide up-to-date education materials, eliminate transportation difficulty, and provide access to education in disadvantaged areas (Arkorful & Abaidoo, 2015; Can, 2020). In online classrooms, the feedback students get from their teachers is satisfying (Benda et al., 2007). It eliminates communication barriers; motivates students to interact with the teacher and the other students (Arkorful & Abaidoo, 2015; Karakaya et al., 2020); because teachers could manage the classroom with a much more student-centered philosophy than a traditional learning environment. In addition, by using virtual classrooms, teachers could use various methods of learning, some of which might be difficult to practice in face-to-face classrooms (Albashtawi & Al Bataineh, 2020).

Apart from these opportunities virtual classrooms have some challenges (Adnan & Anwar, 2020; Arkorful & Abaidoo, 2015; Can, 2020; Muilenburg & Berge, 2005; Yilmazsoy et al., 2018). They are the technical problems in internet connection or connection speed (Akkus & Acar, 2017; Can, 2020), course content and teaching materials inadequacy, students' attention problems, interaction decrease with other students (Finnegan et al., 2008; Rufai et al., 2015), security, privacy and copyright problems (Chen & He, 2013; Hsu et al., 1999), lack of infrastructure and equipment, and internet access problems in disadvantaged regions (Adnan & Anwar, 2020; Muilenburg & Berge, 2005). There could also be undesirable behaviors (writing messages, sharing images, chatting, visiting different websites) of learners in virtual environments (Ko & Rossen, 2017; Can, 2020).

There are some key features to help to realize teaching in virtual classrooms. These features are significant; because they are the facilitators to deliver a virtual classroom that is as effective and lively as face-to-face classroom instruction (Christopher & Hyder, 2014; Rufai et al, 2015). Students focus on the screen, and the teacher shares the course content during the content sharing and screen sharing feature. The audio feature enables teachers and students to speak and listen to each other. The chat feature allows teachers and students to communicate with text messages in real-time. This feature could be functional in keeping the interaction lively and engaging. The drawing and pointing tools are active with the content sharing feature. Teachers and students could use this illustration feature to mark something and draw attention to it when a slide or whiteboard is displayed. The polling feature is about asking a polling question; and collecting information on students' ideas, knowledge level, or readiness for the course. The replies to polling questions are anonymous, which is good to protect privacy. There is also an instant feedback feature such as raising a hand or an emotion indicator. This feature enables students to communicate with the teacher without interrupting the flow of the instruction. The breakout room feature allows teachers to divide students into groups. And students could work collaboratively in their small groups while teachers could move from one breakout room to another to check the assigned work of group members. The video feature is about the image broadcast of teachers and students. Teachers could prefer to display her image, and she could also ask students to use their webcam at times. File sharing is also available during the course. Students could easily download the files that the teacher shares.

Virtual classroom management

Classroom is a special environment where learning and teaching take place, and where students and teachers spend most of their time in school. Many studies have found that classroom management is one of the most important elements that influence learning (Djigic & Stojiljkovic, 2011; Marzano et al., 2003; Wang et al., 1993). There are many definitions of classroom management, and they generally emphasize the positive and appropriate learning environment (Brophy, 2010; Doyle, 1986; Randall, 1992), effective coordination of all classroom and instructional elements like an orchestra management (Basar, 2001; Celep, 2008; Uysal et al., 2014); and control of student behavior, maintenance of learning order and environment (Doyle, 1986; Celik, 2002). All these definitions clearly show us that a teacher's skill to successfully manage a classroom covers many components such as lesson plan, teaching method, time, educational activity, materials, place, positive learning climate, relationship, discipline, and order. Classroom management tries to ensure and sustain an orderly environment for students' academic learning and intends to cultivate students' social and moral growth (Evertson & Weinstein, 2006).

There are a few approaches to classroom management as the term encompasses various aspects of a classroom environment. Traditionally classroom management was seen from the degree of control point of view, and teachers led students basically with rewards or punishments (Burden, 1995; Wolfgang & Glickman, 1986). Later the views have evolved towards more humanistic and democratic thought. According to Wolfgang (1995)'s classroom management framework, there is a control continuum from teacher-centered, to shared and to student-centered perspective. There are basically four orientations to class discipline as traditional, liberal progressive, socially critical, and laissez-faire (Egeberg et al., 2021). The traditional way of classroom management is

interventionist. Liberal progressive teachers are much more democratic, interactionalist and they share power with their students. Teachers with socially critical orientation regard disruptive classroom behavior as a stand against injustice. Teachers with laissez-faire orientation have non-interventionist way of thinking and behavior (Egeberg et al., 2021; Wolfgang & Glickman, 1986). Contemporary thinking of teaching and therefore classroom management emphasize students' active participation, self-regulation, social interaction, and higher order thinking skills (Brophy, 1998; Egeberg et al., 2021). And teachers play the role of facilitators.

Although it is possible to find several approaches to virtual classroom management, there is still a shortage of well-defined ones. Virtual classroom management is about all efforts to provide and maintain a suitable learning environment for the effectiveness of learning in the virtual environment (Can, 2020). A virtual classroom undoubtedly requires management skills from different perspectives than a traditional classroom. It has its own learning theories and e-learning pedagogy models though traditional learning theories and classroom management models form their basis. The Community of Inquiry Online Learning Model by Garrison, Anderson & Archer (2000) highlights the three presences, namely social, cognitive, and teaching, and shows up in relationships and interactions among students and teachers. In the Connectivism Theory by Siemens (2004), learning happens through forging connections and building out networks to connect larger ones. Online Collaborative Learning (OCL) theory by Harasim (2012) is about the learning setting opportunities of the internet that stimulate cooperation, collaboration, and knowledge development. The three main e-learning models are Mayer's Cognitive Theory of Multimedia Learning, Laurillard's Conversational Framework, and Salmon's Five Stage Model. Cognitive Theory of Multimedia Learning puts forth a model based on cognitive theories, which are dual-channel, limited capacity, and active processing assumption (Mayer, 2014). Laurillard's Conversational Framework introduces six key learning types- acquisition, investigation, discussion, practice, collaboration, and production- to design online learning (Laurillard, 2002). Salmon's Five Stage Model of teaching and learning online (Salmon, 2013) encompasses stages of access and motivation, socialization, information exchange, knowledge construction, and review to help teachers develop an online active learning environment. Virtual classroom management dimensions are like traditional classroom management dimensions, but still, they vary considering the diversity of the digital teaching environment. These dimensions could be grouped as teaching and learning environment, management of teaching and learning, behavior management, interaction, motivation, technology management, management of students with special needs, and time management (Can, 2020). Undoubtedly, teachers should consider each of these dimensions when designing and managing an online course.

METHOD

Phenomenology is a practical methodological design in qualitative research to comprehend the phenomena based on how the participants experience them. The current research aims to understand and interpret the participants' experiences of virtual classroom management. We utilized van Mannen (1997)'s phenomenological point of view, which is the study of lived experience, to provide an engaging and vivid description of participants' behaviors, and actions. According to van Manen (1997; 2014) and other eminent researchers in this field, there is no defined procedure for doing phenomenological studies. Phenomenology seeks to comprehend the nature and significance of our daily experiences. It asks, "What does this or that experience feel like?" (van Manen, 1997). Phenomenological inquiry starts with pre-data collection strategies and progresses up to data analysis (Moustakas, 2014).

Research Participants

We utilized criterion-based purposeful sampling and snowball sampling strategies (Merriam, 2009; Patton, 2002) to get rich and meaningful data. All participants were public lower secondary school teachers in Istanbul and taught online for at least one semester long. The demographic information of participants is listed in Table 1:

Table 1. Participants' Demographics

Participants	Gender	Age	Years of service	Graduation	Teaching field	IT skills
P1	F	34	10	Undergraduate	Science	Good
P2	M	45	21	Undergraduate	Social Sciences	Medium
P3	F	36	9	Master	Science	Good
P4	M	28	7	Undergraduate	Turkish	Medium
P5	F	47	25	Undergraduate	Technology and Design	Medium
P6	F	30	8	Undergraduate	Social Sciences	Good
P7	M	33	10	Undergraduate	English	Good
P8	M	33	8	Undergraduate	Mathematics	Medium

P9	F	42	20	Undergraduate	Social Sciences	Medium
P10	F	32	7	Undergraduate	English	Medium
P11	F	30	7	Undergraduate	Mathematics	Medium
P12	F	53	30	Undergraduate	Turkish	Medium
P13	M	38	11	Undergraduate	English	Good
P14	F	28	7	Undergraduate	English	Good
P15	F	38	9	Undergraduate	Religion	Medium
P16	F	29	7	Undergraduate	Turkish	Medium
P17	M	53	26	Undergraduate	Mathematics	Medium
P18	F	48	26	Undergraduate	Science	Good
P19	M	51	24	Undergraduate	Social Sciences	Medium
P20	F	45	22	Undergraduate	English	Medium
P21	F	35	12	Undergraduate	Science	Good
P22	F	38	16	Master	IT	Good

As depicted in Table 1, 15 participants were female, and seven were male. Three of the participants were younger than 30, 11 were in the age range of 31-40, five were in the age range of 41-50, and three were between the ages of 51-60. Only two participants received a master's education while the others were undergraduates. As for the teaching fields, there were four Science, four Social Sciences, three Turkish, one Technology design, five English, three Mathematics, and one IT teacher. Nine teachers stated that their IT skills were good, and 13 of the teachers said their IT competency was medium level.

Data Collection

We gathered data in the 2022-2023 education year with 22 teachers, which was our data saturation level. The data collection tool was open-ended questions in a written format (Bengtsson, 2016). The form included six primary and 13 probing open-ended questions, a few examples of which are “What do you think about virtual classroom management?” “What was your virtual classroom climate like? Could you please explain?” “How do you manage time while teaching in the virtual classroom?” During the preparation of questions, existing literature was reviewed. Opinions were obtained from two experts in the field to enhance the validity and reliability of questions. A final version of the questions was then determined.

All components of the research process, from the research questions to the data analysis and interpretation, were attempted to be transparently documented to assure the credibility and transferability of the study. Research participants were chosen through purposeful sampling to provide a comprehensive and diverse variety of experiences and opinions relevant to virtual classroom management. Researchers assessed the intercoder reliability and carefully outlined the coding frame while analyzing the data. Direct quotes from participants were also included in the study report to fulfill the confirmability criterion and show that the conclusions were based on the perspectives and experiences of the participants.

Researchers’ Role

In qualitative research, it is quite hard to ensure the impartiality of the researcher, and it is necessary not to interfere with the natural environment of the researched subject, event, and phenomenon (Yildirim & Simsek, 2006). In this study, the researchers tried to be impartial and careful not to influence the participants. Being sensitive to the natural environment, we tried to be open, flexible, and unbiased with the participants, the data collection, the analysis, and the presentation of the findings. In addition, researchers need to be conscious of how their personal prejudices, life experiences, and viewpoints may affect the way they conduct their study and the conclusions they draw. For this reason, we tried to be self-reflective and employed constant comparison (Glaser, 1965) to make sure that our findings and interpretations are based on the data rather than influenced by prejudices.

Research Ethics

In this study, all the rules specified within the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics" have been taken.

The research study was ethically approved by the Research Ethics Board of XXXX University, numbered XXX, and dated XXX. The researchers informed the participants of the purpose of the research and the data collection process and obtained their informed consent. The participants all knew that they had a withdrawal option whenever they wanted. The privacy and anonymity of participants were upheld through labeling instead of using their real names. All the data are kept in password-protected electronic files and will be disposed of once they are not needed.

Data Analysis

Analysis was carried out by rigorously implementing inductive content analysis. The process of concluding data using new understanding to develop theories is called inductive content analysis. Researchers examine the material with an open mind, searching for relevant topics to address the research questions (Bengtsson, 2016; Krippendorff, 2004). Thus, the transcribed data was read back and forth and interpreted holistically. The researchers performed the analysis and the inductive coding process with MaxQDA qualitative analysis software package. The researchers individually coded the data, then compared and discussed the inconsistencies. The coding frame is crucial to improve transparency and systematicity of the coding process (Bryman & Bell, 2015; O'Connor & Joffe, 2020). The researchers assessed the intercoder reliability during the development of coding frame and reached 90% fit value which is satisfactory according to Miles and Huberman (1994). The coding frame was revised until compromised on the common final version of sub-codes, codes, and themes (see Table 2, 3, 4, 5).

FINDINGS

To address the research questions, data was analyzed, and findings were arranged as sub-codes, codes, and themes. Through reading and re-reading the data and clustering the codes and sub-codes, four main themes represented the virtual classroom management phenomenon. Figure 1 shows the themes.

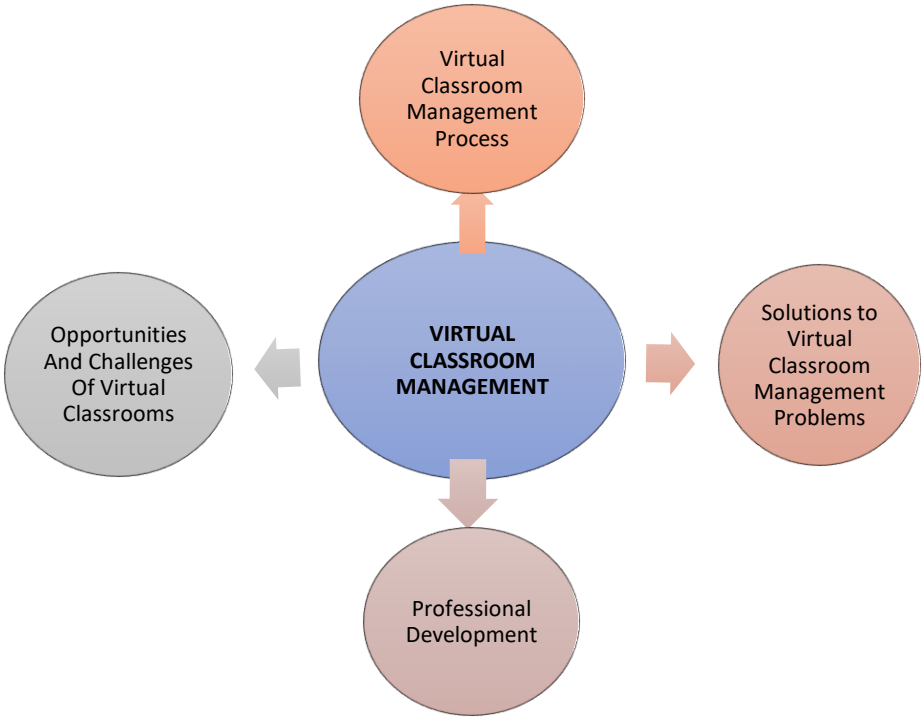

Figure 1. *The themes of virtual classroom management*

As seen in Figure 1, virtual classroom management dynamics and strategies were grouped under themes of (1) Virtual Classroom Management Process, (2) Professional Development, (3) Opportunities, and Challenges of Virtual Classrooms, and (4) Solutions to Virtual Classroom Management Problems.

The following table (Table 2) presents an overview of the Theme 1, codes, sub-codes, number of units of analysis, and frequencies.

Table 2. Coding Frame with the Units of Analysis and Frequency Regarding Theme 1: Virtual Classroom Management Process

	No. of units of analysis (coded segments)	n	%
Theme 1: Virtual Classroom Management Process	549	22	100%
Related codes and sub-codes:			
Teaching Methods	178	22	100%
Virtual Classroom Context	217	22	100%

Motivation	106	22	100%
Discipline	68	22	100%
Time management	43	21	100%
Feelings to Virtual Classrooms	59	20	90.9%
Assessment Methods	69	22	100%
Asynchronous Learning	26	18	81.8%

The Virtual Classroom Management Process theme reveals the experiences and opinions of participating teachers in the virtual classroom management process in terms of method, context, and emotional states. As Table 2 shows, Theme 1: Virtual Classroom Management Process is the theme that the participating teachers emphasized the most and expressed the most opinions among all the other themes (no of units of analysis [NoUoA]=549). As can be seen from the frequency information in Table 2, all the participating teachers (n=22) expressed their views about Theme 1: Virtual Classroom Management Process, Codes of Teaching Methods, Virtual Classroom Context, and Assessment Methods. The subject teachers focus on most is Virtual Classroom Context (NoUoA=217), and the most mentioned sub-code is Motivation (NoUoA=106). Meanwhile, the least uttered code is Asynchronous Learning. Direct quotations of some participants regarding Theme 1 are as follows:

P10: "*I was always with the same students; they were always attending. While some of them were students who were willing and participated in the flow of the lesson, some were those attending just because of necessity. It was annoying that unwilling students had no idea about what we were doing. When I called out their names and got no answer, I got demoralized. It was a tense and quiet environment, and other students were also affected*." (Theme 1: Virtual Classroom Management Process, Code: Feelings to Virtual Classroom)

P4: "*I got into contact with the family and other teachers for the evaluation. We evaluated together the assessment statistics of the students over the education information network (EBA) of the Ministry of National Education. We enabled them to deliver some assignments to us as hard copies. I also applied the verbal assessment method*." (Theme 1: Virtual Classroom Management Process, Code: Assessment Method)

P21: *I applied the principle of active learning, learning by doing. For example, 5th graders designed their parachutes on air resistance. They recorded slow-motion videos by throwing them out of the window, and they shared them in the lesson, and by scoring them, we carried out an entertaining activity in which we included the parents. The online course was usually like hours of sharing them. There were many activities outside the classroom.* (Theme 1: Virtual Classroom Management Process, Code: Asynchronous Learning)

P8: *It was a question-and-answer session with the students. I used discussion, question-answer, and such activities at first. I could not use any technique later because I taught the lesson with just 2-3 students. I tried to communicate by asking questions, but nearly nobody replied. Usually, they were just in the class, but their microphones were not working.* (Theme 1: Virtual Classroom Management Process, Code: Teaching Methods)

The following Table 3 presents an overview of the Theme 2, codes, sub-codes, number of units of analysis, and frequencies.

Table 3. Coding Frame with the Units of Analysis and Frequency Regarding Theme 2: Professional Development

	No. of units of analysis (coded segments)	n	%
Theme 2: Professional Development	55	22	95.4%
Related codes and sub-codes:			
2.1. Feeling Competent in Managing the Virtual Classrooms	15	7	31.8%
2.1.1. Trial and error	2	1	4.5%
2.1.2. Easy	2	2	9%
2.1.3. Medium difficulty	11	3	13%
2.2. Lack of Professional Knowledge	19	12	54.5%
2.3. Professional Development Needs	21	15	68.1%

The theme of Professional Development reveals the professional development experiences of participating teachers in terms of virtual classroom management and their expectations in this regard. As seen in Table 3, all the participating teachers (n=22) expressed their opinions about Theme 2: Professional Development. However, there was no code that all of them commented on (see Table 3). Professional development needs code was the most frequently discussed (NoUoA=21) issue by the highest number of participants (n=15). The least mentioned code is Feeling Competent in Managing the Virtual Classrooms (NoUoA=15), and the least mentioned sub-codes are Trial and error and Easy (NoUoA=2). Direct quotations of some participants regarding Theme 2 are as follows:

P2 "*I never used online classroom applications before. I had some theoretical knowledge. My experience increased over time. It was a bit of trial and error. I tried to help my students as much as I could. I hope I did.*" (Theme 2: Professional Knowledge, Code: Feeling Competent in Managing the Virtual Classrooms, Sub-code: Trial and error)

P7: "*I did not receive any training on it. I directed the flow of the lesson according to trial and error and feedback from the children. After a while, I started to teach efficient lessons. When I thought my endeavor was inadequate and a waste of time, I realized that students could learn, and virtual lessons could be a way to teach. I can consider myself successful.*" P7 (Theme 2: Professional Knowledge, Code: Feeling Competent in Managing the Virtual Classrooms / Lack of Professional Knowledge, Sub-code: Trial and error)

P8: "*I am a Mathematics teacher. I had a hard time without the slightest in-service training and material support. I did not have any training in online classrooms during my university years. I got to learn during the pandemic period*." (Theme 2: Professional Knowledge, Code: Feeling Competent in Managing the Virtual Classrooms / Lack of Professional Knowledge)

P20 "*I did not take any training. I did not have any experience. I cannot say that I am very knowledgeable. When I compare myself with my knowledge before the pandemic, I can easily say that I have improved a lot and gained experience*." (Theme 2: Professional Knowledge, Code: Feeling Competent in Managing the Virtual Classrooms / Professional Development Needs)

Table 4 depicts an overview of the Theme 3, codes, sub-codes, number of units of analysis, and frequencies.

Table 4. Coding Frame with the Units of Analysis and Frequency Regarding Theme 3: Advantages and Disadvantages of Virtual Classrooms

	No. of units of analysis (coded segments)	n	%
Theme 3: Opportunities and Challenges of Virtual Classrooms	311	22	100%
Related codes and sub-codes:			
3.1. Pros and Cons	18	14	63.6%
3.2. Disadvantages and Challenges	233	22	100%
3.2.1. Social integration challenges	26	12	54.5%
3.2.2. Self-regulation challenges	62	18	81.8%
3.2.3. Infrastructural challenges	28	16	72.7%
3.2.4. Challenges regarding the parents	41	17	77.2%
3.2.5. Challenges of teachers	70	21	90.9%
3.2.6. Other challenges	6	5	45.4%
3.3. Opportunities	60	20	90.9%
3.3.1. Comfortable	28	15	68.1%
3.3.2. Flexibility of time and place	15	11	50%
3.3.3. Effective lesson	17	8	36.3%

The Opportunities and Challenges theme includes participating teachers' positive and negative ideas and experiences about virtual classroom management. As Table 4 shows, all teachers gave their opinions about the third theme of the study, the Opportunities and Challenges of Virtual Classrooms. Table 4 details the issue that all the teachers (n=22) focused on the most (NoUoA=233) related to the disadvantages and challenges. The most frequently repeated issue was the Challenges of Teachers (NoUoA=70). On the other hand, the code with the least number of views (NoUoA= 18) was Pros and Cons. Teachers reported the opportunities of virtual classrooms as the lessons were comfortable (NoUoA=28), flexible in terms of time and place (NoUoA=15), and effective (NoUoA=17). Direct quotations of some participants regarding Theme 3 are as follows:

P16 "*We couldn't get immediate feedback from students. Sometimes I was like talking to myself, and I wondered if they were listening. From time to time, I witnessed that the students were in different environments, not a suitable environment for learning. There were times when external voices came through. For example, during a lesson, a student asked a question. When he turned on his microphone to answer, other family members' voices in the same environment were louder than the child's. Most probably, the number of rooms was not enough. Maybe the heating system was only for one room. These kinds of things make it hard to manage the lesson.*" (Theme 3: Opportunities and Challenges of Virtual Classrooms, Code: Disadvantages and Challenges, Sub-code: Problems regarding the parents / Infrastructural problems / Other problems)

P15: The *constant stay of the student or teacher in the virtual environment can cause a lack of interpersonal communication and psychological problems such as anxiety. At first, I found it strange to enter the classroom. I had difficulties in this regard. In the classical class, we build face-to-face communication with the student who has lost focus on the lesson or did not understand. The teacher can understand it by watching the student. But the camera was turned off. I could not understand them because there was no chance to observe the students*. (Theme 3: Opportunities and Challenges of Virtual Classrooms, Code: Disadvantages and Challenges, Sub-code: Social integration challenges)

P4: *I think virtual classrooms are vital today and will be in the future. I believe that this opportunity should be possible at every level of education. The development of technology and the opportunity to access information from anywhere are necessities of the age. The advantages are everyone participates in the classroom regardless of the place; no one feels any difference physically; they are comfortable; physically away from classmates, which is a way to prevent them from being badly influenced and physically distracted... Also, climate conditions and natural events cannot affect education*. (Theme 3: Opportunities and Challenges of Virtual Classrooms, Code: Opportunities, Sub-code: Comfortable / Flexibility of time and place)

Table 5 below shows an overview of the Theme 4, codes, sub-codes, number of units of analysis, and frequencies.

Table 5. Coding Frame with the Units of Analysis and Frequency Regarding Theme 4: Solutions to Virtual Classroom Management Problems

	No. of units of analysis (coded segments)	n	%
Theme 4: Solutions to Virtual Classroom Management Problems	187	22	100%
Related codes and sub-codes:			
4.1. Solutions Regarding Teachers	75	21	90.9%
4.1.1. Being competent in digital pedagogies	33	17	77.2%
4.1.2. Willingness to learn and professionally develop	24	13	59%
4.1.3. Collaboration	10	9	40.9%
4.2. Structural Solutions	69	19	86.3%
4.2.1. Course design	18	11	50%
4.2.2. Infrastructural solutions	14	10	45.4%
4.2.3. Trainings for students and parents	29	10	45.4%
4.3. Lack of solutions	14	8	36.3%

Another topic participant teachers mentioned about virtual classroom management was Solutions to Virtual Classroom Management Problems. This theme (Theme 4) sheds light on the expectations of participating teachers concerning solutions. As shown in Table 5, Theme 4 includes codes for Solutions Regarding Teachers, Structural Solutions, and Lack of Solutions. Among the participating teachers (n=21), the Solutions Regarding Teachers code was the most frequently discussed (NoUoA=75). The most suggested solution under this code was the importance of Being competent in digital pedagogies (NoUoA=33). Collaboration was the least discussed solution proposal regarding teachers (NoUoA=10). Some direct quotes from the participants regarding Theme 4 are as follows:

P1: *When planning virtual lessons, teachers should prepare lesson plans that are enriched with different methods and techniques, considering the individual needs of each student and that they can attract their attention. Teachers need to have a technological pedagogical knowledge background. They should be able to prepare a lesson plan enriched with techniques suitable for the students. Of course, this is possible if every student has technological opportunities. Some students could not participate in the distance education process. And they were unfortunately left out of education.* (Theme 4: Solutions to Virtual Classroom Management Problems, Code: Solutions Regarding Teachers, Sub-code: Being Competent in Virtual Pedagogies / Willingness to learn and professionally develop)

P4: *We tried to solve the problems by communicating with the parents and other teachers. We evaluated the academic result statistics of each student on EBA together with parents. We enabled students to connect with us physically, face-to-face, too. To find solutions to problems, we could meet with colleagues with experience and those who attended any prior training about online classrooms*. (Theme 4: Solutions to Virtual Classroom Management Problems, Code: Solutions Regarding Teachers, Sub-code: Collaboration / Willingness to learn and professionally develop)

P7: *At first, both the students and I had difficulties. But once I got used to it, the students were willing to learn. I realized that this was not so much different from face-to-face education. The students had the right to*

speak by raising their hands and asking. I tried to keep the students active by engaging them in physical activities because students had already been bored with the pandemic and were locked in their homes. I was striving for effective learning by listening to English songs and animating the lyrics. Online classrooms could be very comfortable environments for students who want it. It is necessary to keep their interest alive as much as possible. By adding games to learning, watching videos, and preparing worksheets that will attract their attention, I aimed to keep children interested in the lesson and learning while having fun. Over time, we all got used to the situation; and overcame most of the difficulties. I think, first, the teacher should be a good computer and internet user. Since children's attention can easily be distracted, teachers should adopt exercises and lectures online and attract children's attention. (Theme 4: Solutions to Virtual Classroom Management Problems, Code: Structural Solutions, Sub-code: Course design)

P18: *Online education can never replace face-to-face learning. Online classrooms could only be considered for special situations. I do not find it appropriate under normal conditions. We teachers should use online classroom applications in mandatory cases. Apart from these situations, it is a very useless and unsuccessful way of education.* (Theme 4: Solutions to Virtual Classroom Management Problems, Code: Lack of solutions)

DISCUSSION & CONCLUSION

Education has witnessed enormous changes in recent years in the name of digitalization. The Covid-19 pandemic has necessitated this process and acted as a catalyst in the transition to the application phase. At the point we have reached today, it is inevitable for education to adapt to the digital age and to provide maximum benefit from the digital world and developments. For example, without boundaries learning anywhere and anytime, personalized approaches to learning, digital game-based learning, blended learning, virtual mentors, and augmented reality approaches are some of the current alternatives offered by the digital world to education. According to the study results, virtual classroom management dynamics and strategies are shaped around four factors. These factors are the Virtual Classroom Management Process, Professional Development, Opportunities and Challenges of Virtual Classrooms, and Solutions to Virtual Classroom Management Problems.

As the findings reveal, the first theme, the Virtual Classroom Management Process, is the one the participating teachers uttered the most. It encompasses codes of teaching methods, virtual classroom context (with the sub-codes of motivation, discipline, and time management), feelings for virtual classrooms, assessment methods, and asynchronous learning opportunities. The code of virtual classroom context was the most mentioned one for all participants, whereas the least uttered code was asynchronous learning. The motivation of students and teachers has come to the fore in the virtual classroom management process. Students' engagement and motivation, situated in the affective domain of classroom management, are fundamental, even the precondition of learning (van Lier, 1996; Wright, 2005), as they directly affect general classroom dynamics, students' learning results, and conduct (Franklin & Harrington, 2019; Kilic et al., 2021; Schiefele, 2017). Teachers' motivation and views of teaching and learning are crucial factors influencing the classroom environment (Radel et al., 2010; Han & Yin, 2016). High levels of teacher motivation and goal orientation increase student motivation (Engin, 2020; Han & Yin, 2016), teaching effectiveness, and improved teaching practice (Thooneen et al., 2011).

The Professional Development theme includes codes of feeling competent in managing virtual classrooms, lack of professional knowledge, and professional development needs. As understood from the interview data, professional development needs were the most frequently discussed issue. Teachers highly need professional development in virtual classroom management. With the Education 4.0 digital transformation process, innovation, creativity, and the design of education processes have gained importance like never before (Harkins, 2008). In this process, it is necessary to rethink learning and teaching processes and reinterpret the roles of teachers accordingly. Teachers' professional development in virtual classroom management is essential to equip teachers with sufficient knowledge and skills to manage online learning environments. There are a few frameworks for the virtual competencies of teachers, such as the SAMR framework of Puentedura (2012), the critical digital framework of Hinrichsen and Coombs (2014), the UNESCO (2018) ICT competencies framework, and the TPACK framework of Mishra and Koehler (2006). Among these frameworks, TPACK draws attention because it draws a comprehensive framework that focuses on technological, pedagogical, and content knowledge (Fayda-Kinik, 2022). In line with all these frameworks, the study results mention the importance and development of teachers' digital competencies and virtual classroom management skills.

All participating teachers talked about the Opportunities and Challenges of Virtual Classrooms, particularly emphasizing the disadvantages and challenges. These challenges were grouped as social integration, self-regulation, infrastructural, and challenges regarding the parents and teachers' challenges. Challenges of virtual

classrooms have also been given a lot of attention in literature. For example, teachers with low online classroom design skills had some challenges with virtual classroom management. They faced hardware and software problems and physical environment problems (Akkus & Acar, 2017; Arslan & Sumuer, 2020; Karakaya et al., 2020). Other virtual classroom management challenges could be listed as problems during the planning, presentation, and evaluation phases (Arslan & Sumuer, 2020; Mohan et al., 2020), communication problems, and students' silence (Neuwirth et al., 2020), some discipline problems such as inappropriate use of chat and camera function, and some distractions (Arslan & Sumuer, 2020; Neuwirth et al., 2020) during online lessons. Many studies shed light on self-regulation as a fundamental skill in online learning (Barak et al., 2016; Cho & Shen, 2013). Consistent with our findings, Carter and colleagues (2020) emphasized that improving students' self-regulation skills would contribute to the effectiveness of online learning. The participants also pointed out the social integration challenges. For many students, the level of isolation that online classrooms may foster among students could cause a poor online learning environment (McInnerney & Roberts, 2004), motivation drop, and disengagement. Salas-Pilco et al. (2022) explored student engagement in online learning and indicated its value in providing educational activities that encourage participation and real-world learning opportunities. Teachers also reported the opportunities of virtual classrooms as comfortable, flexible, and effective. Mashhadi and Kargozari (2011) similarly indicated that virtual classrooms are beneficial because they allow students to learn outside of the classroom's walls in the community and involve them in real-world tasks.

Solutions to Virtual Classroom Management Problems was another subject that participating teachers brought up concerning virtual classroom management. This theme consists of codes of solutions regarding teachers, structural solutions, and lack of solutions. Teachers emphasized being competent in digital pedagogies and the need for professional development training. Similarly, quite a few studies in the literature (Fayda-Kinik, 2022; McGarr & McDonagh, 2021; Reisoglu & Cebi, 2020) investigated teachers' professional development needs to enhance their digital skills, classroom management competencies and their expectancy in this direction. Other solutions were identified as structural solutions divided into sub-codes of course design, infrastructural solutions and training for students and parents. These findings are related to the online learning models and e-learning pedagogies such as the Connectivism theory by Siemens (2004), Online collaborative learning (OCL) theory by Harasim (2012), and Salmon's (2013) Five Stage Model. A practical course design guarantees that the learning objectives, teaching strategies, and evaluation criteria are all in line. The learning environment is organized, engaging, and participatory. It supports various devices and technological aids, as well as multiple methods of learning and content representation options.

Additionally, it creates unambiguous communication lines, well-rounded assessments, and a timely feedback system. Regarding infrastructural solutions, teachers emphasized the need for personal computers or tablets and uninterrupted free internet for each student. Sari and Nayir (2020) presented similar findings. Implementing learning management systems and online educational platforms into digital learning environments is also the focus of infrastructure solutions (Kerssens & Dijck, 2021). Training for students and parents is mainly about managing distractions and parental involvement and support, especially for younger students. These results are aligned with the literature remarking the participation of parents in monitoring the process and student participation (Budhrani et al., 2021; Knopik et al.,2021; Li et al., 2021; Sari & Nayir, 2020).

Implications and Recommendations

This study presented some remarkable findings that reveal what teachers think about and expect from virtual classroom management. Accordingly, virtual classroom management should be reviewed and reshaped within the framework of digital learning and teaching models, digital learning tools, and assessment principles.

The findings mention the importance and development of teachers' digital competencies and virtual classroom management skills. It could be essential to be inspired by the TPACK framework and to plan the achievements accordingly when designing professional development training for teachers. Apart from that, models specifically for online learning (e.g., Mayer's Cognitive Theory of Multimedia Learning, Laurillard's Conversational Framework, and Salmon's Five Stage Model) introduce some key learning and teaching strategies for virtual classroom management.

These models could be inspiring and stimulating guidelines for educators interested in developing engaging and dynamic learning environments and managing digital interactions while adapting them to changing trends and technological transformations.

The thinking and information processing of new generations, the digital natives, is quite different from the earlier ones. They spend most of their time with computers, mobile phones, and similar digital devices. They have different learning needs in the new society, are technologically prone, and have high awareness in this regard.

They have control of their learning processes, one of the biggest challenges of online learning (Boelens et al., 2017; Anthonysamy et al., 2020). Data-driven research shows that self-regulated learning skills are a vital predictor of academic success, which is about managing one's learning processes (Harris & Graham, 1999; Anthonysamy et al., 2020). The situation is likewise in digital learning environments and virtual classrooms (Barak et al., 2016; Cho & Shen, 2013). Students require competencies in self-regulation that include time management, organization, and self-directed learning to engage in online learning activities successfully and efficiently. Teachers should set goals, monitor progress, encourage reflection, organize the environment, and manage time to help students self-regulate.

Teachers need to transform their teaching and classroom management strategies and pedagogical thinking and include digital student-centered practices in the teaching process to meet the needs of digital students. The Conversational Framework by Laurillard (2002) and the Five Stage Model by Salmon (2013) could guide engaging the classroom environment and solving social integration problems. In addition, ice-breaking activities, group projects or activities, online discussion forums, virtual games, and informal sharing on non-academic topics could be examples of initiatives to increase online social integration. Infrastructure-related solutions could include regulations for hardware and software, assistance on such requirements, digital literacy skills, assurances of online security, access to online resources, IT support for technical issues, and effective learning management systems. Educational administrators should have foresight about such problems related to infrastructure and contact the relevant people to solve the problem by managing the process correctly to help teachers and students have a more productive, engaging, and efficient virtual learning process.

Distractions like gaming, social networking, or domestic chores might be prevented when learning online. Students may require parental assistance in learning online and controlling distractions. Parents might need help to teach their kids to be goal-oriented, prioritize their work, and establish a regular schedule. Schools and educational institutions may offer parents assistance to deal with these issues. They may provide technical support, enable communication between parents and teachers, host seminars or tutorials on utilizing online learning platforms, and give advice on supporting students' academic and emotional needs while pursuing an education online. Collaboration between schools, teachers, and parents seems critical to solve all these issues.

Limitations and Further Research

Due to the nature of qualitative studies, there are some limitations. The findings cannot be generalized and are limited only to the participants. Although the data was presented directly and in detail in terms of transferability, and the analysis process was depicted transparently with the coding frame, the interpretation of phenomenological data largely depended on the researchers' subjective perception.

A broader and more generalizable perspective could be available by utilizing quantitative or mixed-method studies. Different cultural or geographical contexts could enable us to examine how the phenomenon varies across diverse populations. There are several motivation factors of teachers such as intrinsic, supportive work, recognition, or work-life balance (Casely-Hayford et al., 2022; Corkin et al., 2018; Lunenburg & Ornstein, 2008; Power & Goodnough, 2019). Further research could be designed to explore virtual teaching motivational factors of teachers.

Conclusion

In this research, we contacted the teachers to analyze their views about and expectations from the virtual classroom management phenomenon, essential for establishing and sustaining a healthy, desirable, and efficient virtual learning environment. The findings demonstrated the significance of engagement and motivation toward virtual classrooms. Digital competencies and classroom management skills of teachers are two fundamental factors in fostering students' engagement in virtual classrooms. To address the requirements of digital students, teachers need to change their pedagogical ideas, classroom management techniques, and teaching methods to incorporate digital student-centered activities. Additionally, policymakers and administrators should realize the importance of a high standard of open, inclusive, and available online education.

Statements of Publication Ethics

Each author obeys the principles of publication ethics.

Researchers' Contribution Rate

Each author equally contributed to the manuscript by taking part in all stages of the process.

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Aylin Kirişçi-Sarıkaya	☒	☒	☒	☒	☒	☒
Hanifi Parlar	☒	☒	☒	☒	☒	☒

Conflict of Interest

The study has no conflict of interest.

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Perceived Forgiveness Experiences of Young Adult University Students: A Qualitative Study

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Abstract

The prevailing trend in forgiveness studies predominantly addresses the perspective of the victim forgiving the transgressor, with a notable emphasis on the victim's experiences. However, recognizing the inherent relational dynamics of forgiveness, it becomes pertinent to extend scholarly inquiry towards understanding the experiences of individuals who have transgressed. The present study aimed to discover the experiences of university students at the ages of 21 to 30 who had engaged in transgressions within their interpersonal relationships and subsequently received forgiveness from those they had wronged. Employing a qualitative research design and the phenomenological method, information pertaining to these experiences was systematically collected. The study's sample comprised 15 university students, consisting of 8 women and 7 men. The experiences of the participants regarding perceived forgiveness were manually examined by the researchers using the thematic analysis method, and codes, categories, and themes were formed based on the statements of the participants. The findings yielded four overarching themes in total explaining the forgiveness experiences of the participants, namely ‘contact process, ‘relational responsibility/decision-making’, ‘transformative effect of being forgiven’, and ‘value of being forgiven. These identified themes provide comprehensive insights into the nuanced aspects of forgiveness experiences among the participants.

Keywords: being forgiven, feeling forgiven, forgiveness, perceived forgiveness, thematic analysis

Genç Yetişkin Üniversite Öğrencilerinin Affedildiğini Hissetme Deneyimleri: Nitel Bir Çalışma

Öz

Alanyazında affedicilik konusunda yapılan araştırmaların büyük oranda mağdurun hata yapan kişiyi affetmesi kapsamında olduğu görülmektedir. Ancak affediciliğin ilişkisel boyutu düşünüldüğünde bu süreçte hata yapan kişinin deneyimlerinin de önemli olduğu anlaşılabilir. Buradan hareketle bu çalışmada kişilerarası ilişkilerinde hata yapmış ve hata yaptığı kişi tarafından affedilmeyi deneyimlemiş, 21-30 yaş arasında yer alan üniversite öğrencilerinin deneyimlerini keşfetmek amaçlanmıştır. Bu araştırmada nitel araştırma deseni ve fenomenolojik yöntem kullanılarak katılımcıların deneyimleri alınmıştır. Çalışma kapsamında 15 üniversite öğrencisi ile (8 kadın, 7 erkek) görüşülmüştür. Katılımcıların algılanan affedicilik ile ilgili deneyimleri tematik analiz yolu ile manuel olarak araştırmacılar tarafından incelenmiş, katılımcı ifadelerinden kodlar, kategoriler ve temalara ulaşılmıştır. Analiz sonucunda katılımcıların affedilme deneyimlerini açıklayan ‘temas süreci’, ‘ilişkisel sorumluluk/kararlar alma’, ‘affedilmenin dönüştürücü etkisi’ ve ‘affedilmenin değeri’ olmak üzere toplamda dört temaya ulaşılmıştır. Araştırma sonucunda elde edilen bu temalar katılımcıların affedilme deneyimleri hakkında kapsayıcı bir bakış açısı getirmektedir.

Anahtar kelimeler: affedildiğini hissetme, affedilme, affetme, algılanan affedicilik, tematik analiz

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INTRODUCTION

Although perceived forgiveness has usually been discussed in the context of being forgiven by God (Fincham & May, 2019, 2020; Karause & Ellison, 2003; McConnell & Dixon, 2012), there are also definitions associated with perceived forgiveness in interpersonal relationships. Perceived forgiveness refers to the perceptions of offenders or transgressors regarding the extent to which they are forgiven by the victims of their mistakes or relational transgressions (Evelyn, 2013). According to Enright and the Human Development Study Group (1996), transgressors experience forgiveness when they believe that their victims show them compassion, generosity, and love and have diminishing feelings of resentment, condemnation, and desire to get revenge for them. The same study group developed a model defining the characteristics of the forgiveness process as (1) the transgressor accepts and experiences the hurt they caused for the victim and the consequences of this hurt, (2) they feel the need for a change in their relationship with the victim and decide to be forgiven by them, (3) they try to understand the victim and empathize with the victim, and (4) they experience the positive psychological effects of being forgiven by the victim.

In previous studies, perceived forgiveness has been investigated in the context of its relationships to variables such as forgiving oneself and others (Gassin, 1998; Hall & Fincham, 2005; Ingersoll-Dayton et al., 2010; Patton, 1985; Rahman, 2013; Rose et al., 2018; Terzino, 2010; Umberson et al., 2010; vanOyen-Witvliet et al., 2002; Worthington, 2009), guilt (Krause & Ellison, 2003; Zechmeister & Romero, 2002), shame and fear (Evelyn, 2003), depression (Ingersoll-Dayton et al., 2010), anger (Gassin, 1998; vanOyen-Witvliet et al., 2002), reparative behaviors (making up for the transgression) (McCullough et al., 1997; Hall & Fincham, 2005), reconciliation (Ahmed & Braithwaite, 2006), the intensity of the transgression (Evelyn, 2013), happiness (Evelyn, 2013; Gassin, 1998), thankfulness (Evelyn, 2013; vanOyen-Witvliet et al., 2002), repeated offense (Gassin, 1998; McNulty, 2010; Wallace et al., 2008), self-evaluation (Ingersoll-Dayton et al., 2005), trust (Gassin, 1998; Wieselquist, 2009), gender and age (Hayward & Krause, 2013; Miller & Worthington, 2010), quality of life (Winkelman et al., 2011), bullying (Ahmed & Braithwaite, 2006), relationship quality and self-blame (Friesen et al., 2005), communication styles (Knight, 2018), hurt and life purposes (Lyons et al., 2011), and personality characteristics (Walker & Gorsuch, 2002).

Perceived forgiveness generally brings about positive outcomes in the context of individual and interpersonal relationships. Hall and Fincham (2008) stated that experiencing being forgiven by their victims may make it easier for transgressors to forgive themselves. In the study investigated the factors effective on the self-forgiveness process, Terzino (2010) determined that those who had the experience of being forgiven following a relational transgression and those who imagined being forgiven in a hypothetical scenario had higher self-forgiveness scores. Perceived forgiveness may facilitate not only the self-forgiveness process of the individual but also their process of forgiving others. Researchers have reported a strong link between the experience of being forgiven and the person's ability to forgive others (Gassin, 1998; Patton, 1985; Worthington, 2009). Ingersoll-Dayton et al. (2010) found a negative relationship between the feeling of being unforgiven by others and the variable of forgiving oneself and others.

It has been observed that there is a reduction in the guilt felt by transgressors when they are forgiven (Bauer et al., 1992; Gassin, 1998; Krause & Ellison, 2003; Witvliet et al., 2002; Zechmeister & Romero, 2002). vanOyen-Witvliet et al. (2002) concluded that in scenarios where participants imagined receiving compassionate responses from the victim, there were favorable changes in their basic emotions such as sadness and anger and their moral emotions such as shame, guilt, thankfulness, and hope. In another study conducted with the participation of university students, Evelyn (2013) found that in the case of feeling high levels of being forgiven, there was a positive relationship between the intensity of the transgression and the emotions of guilt and shame. In the same study, it was determined that when the victim forgave the transgressor, the transgressor's expectations of being retaliated against or punished by the victim decreased, and regardless of the intensity of the transgression, this situation was effective in the alleviation of the emotion of fear felt by the transgressor. As a result, it was concluded that the experience of forgiveness faced by the participants was positively associated with their emotions of thankfulness and happiness. Ahmed and Braithwaite (2006) observed that in a scenario in which adolescent participants imagined bullying their partners during a game, their assessment of their parents being more forgiving negatively predicted their stances of shame displacement, which is characterized by victim-blaming and anger against the victim regarding own bullying behaviors, and this resulted in lower levels of bullying behaviors. It was also seen that the effect of a change in shame on bullying took place indirectly via perceived forgiveness and

reconciliation. According to these results, one could state that perceived forgiveness facilitates the reduction of some negative emotions.

Perceived forgiveness also affects emotions such as happiness, joy, relief, and trust. Ingersoll-Dayton et al. (2005) stated that the experience of being forgiven by the victim can lower the negative self-evaluation levels of the transgressor, and this can bring positive psychological outcomes such as relief and joy. Gassin (1998) reported that most young adult participants listed the initial effects of perceived forgiveness as relief, joy, reconciliation, trusting the victim, and the motivation to not hurt them again. The participants also mentioned developments such as refraining from treating the victim insensitively again, self-forgiveness, noticing that people are forgiving, respecting people more, forgiving others more, feeling unconditional love, recognizing own responsibilities, acknowledging the effects of own behaviors on other individuals, feeling safe, treating the forgiving person more respectfully, feeling relationally closer to the person who is the victim of the transgression, and perceiving social support.

It was determined that perceived forgiveness levels in intimate relationships were associated negatively with self-blame and positively with forgiving one's partner and the quality of the relationship (Friesen et al., 2005). Among married university students, Wieselquist (2009) found a positive relationship between perceiving one's spouse as forgiving and one's trust in their spouse. It was also understood that trust, satisfaction, and relationship investment had a mediator role in the relationship between perceived forgiveness.

In line with the available literature, interpersonal relationships can be considered a significant variable in the process of forgiveness. In a sample of university students, Knight (2018) investigated the effect of the style of communication between the transgressor and the victim on perceived forgiveness. As a result, it was revealed that the perceived forgiveness level of the transgressor was positively associated with the appeasement/positivity communication style, which corresponds to compensatory behaviors for the alleviation of the effects of the transgression and the appeasement of the victim, and the apology/concession communication style, which corresponds to privileges for the victim, the acceptance of a mistake, and apology. The avoidance/silence communication style, which is characterized by the avoidance of communicating in relation to the transgression, on the other hand, was found to be negatively associated with perceived forgiveness. In general, the results of previous studies have shown that for the transgressor, the experience of being forgiven has some positive emotional, cognitive, and behavioral outcomes.

Research Problem and Objective

Perceived forgiveness has been identified as a catalyst for positive outcomes within individual and interpersonal relationships. It has been suggested that perceived forgiveness is positively associated with emotions such as happiness, joy, relief, and trust (Gassin, 1998; Ingersoll-Dayton et al., 2005), as well as with the development of relationship quality between the victim and the transgressor (Friesen et al., 2005; Wieselquist, 2009). Furthermore, available literature indicates that perceived forgiveness diminishes negative self-appraisal (Friesen et al., 2005) and facilitates self-forgiveness and forgiveness of others (Gassin, 1998; Hall & Fincham, 2008; Patton, 1985; Terzino, 2010; Worthington, 2009). While available literature shows that perceived forgiveness is associated with positive relationships, encompassing positive emotions, self-forgiveness processes, and the development of relationship quality, it is noteworthy that the existing studies on perceived forgiveness are not sufficiently comprehensive because the focus in forgiveness processes predominantly revolves around the experiences of the victim. Nevertheless, recognizing the experiences of the transgressor and their attitudes towards the victim in the aftermath of an offense could contribute significantly to the understanding of the development of interpersonal relationships disrupted by transgressions. In light of these considerations, this study aimed to explore the experiences of young adults who have committed transgressions in their interpersonal relationships and have felt forgiven. Additionally, the study sought to understand the transgressor's views on the effects of the offense on the victim, the relational exchange processes between the transgressor and the victim, factors that positively or negatively influence the forgiveness process, the effects of perceived forgiveness on the transgressor, and changes in the attitudes of the transgressor towards forgiveness following the experience of being forgiven.

METHOD

This study adopted the qualitative research method known as the interpretive phenomenological design, which focuses on the processes in which people make sense of their experiences. Phenomenology aims to understand the actions and experiences of the individual, rather than the objective "reality" of an experience. This form of analysis allows the in-depth understanding of a phenomenon through the detailed explanations of insights by the individuals who have the relevant experience (Creswell et al., 2011).

Participants and Interviews

The data of interpretive phenomenological analysis studies are collected from small samples consisting of individuals who have experienced a specific phenomenon (Creswell & Clark, 2011; Ritchie et al., 2013). It has been stated in general that six to eight participants are sufficient for qualitative studies (Kuzel, 1992; McCraken, 1988; Morse, 1994). The participants of this study, which aims to examine the perceived forgiveness experiences of young adults, consisted of a total of 15 young adult university students, 8 women and 7 men aged between 21-30, who had experienced being forgiven after their transgressions in their interpersonal relationships. Before collecting data, ethical approval was obtained from the Scientific Research and Publications Ethics Committee of Kahramanmaras Istiklal University. In the context of the research, the criteria for inclusion were established based on Enright and the Human Development Study Group's (1996) forgiveness model. These inclusion criteria encompass the transgressor's recognition of the harm inflicted upon the victim and the awareness of the effects of this harm during the forgiveness process. Furthermore, the responsibility to initiate changes concerning the harm inflicted on the victim and the deteriorated relationship with the victim after the offense were identified as integral components of the inclusion criteria. Volunteers participating in this study were provided with a form generated through the Google Forms platform to assess their demographics and ascertain whether they met the predetermined inclusion criteria. The form included questions on age, sex, education level, the transgression in question, when this transgression was made, the responsibilities and compensatory behaviors regarding the transgression, the level of closeness before the transgression, the change in closeness after the transgression, the degree to which the individual felt forgiven, and the importance of forgiveness. Additionally, to more thoroughly assess whether individuals completing the survey met the inclusion criteria, individual telephone interviews were conducted to gather information about their experiences with forgiveness. A total of 21 individuals who volunteered to participate in the study were reached through the survey. Following the interviews and evaluations, 15 individuals who met the inclusion criteria outlined above were included in the study. However, six individuals who volunteered for the research were not included. These individuals expressed a lack of responsibility for the offense, did not exhibit compensatory behaviors for their mistakes, reported no changes in their relationship with the victim following the offense, and did not perceive themselves as forgiven. Demographic information about the participants in the research is presented in Table 1.

Table 1. Participant Demographics

Participants	Sex	Age	Educational Status	Transgression
P1	Female	28	Master	Speaking harshly against a friend's unrealistic expectations
P2	Male	28	Bachelor	Causing the death of a close friend's beloved cat
P3	Female	22	Undergraduate	Making hurtful jokes towards a friend
P4	Male	21	Undergraduate	Speaking negatively about the romantic relationship of someone of interest
P5	Female	30	Bachelor	Withholding important information from a partner
P6	Male	21	Undergraduate	Displaying violence towards a sibling
P7	Female	22	Undergraduate	Misinterpreting and acting hurtful towards a boyfriend
P8	Female	24	Bachelor	Purposefully failing to provide support to a sibling in need
P9	Male	21	Undergraduate	Acquiring a friend's personal information through a fake account
P10	Male	23	Undergraduate	Exploiting a friend for personal needs
P11	Female	27	Undergraduate	Engaging in demeaning actions towards one’s father
P12	Male	23	Undergraduate	Making hurtful accusations against a close friend
P13	Male	21	Undergraduate	Reacting harshly towards one's father
P14	Female	27	Master	Using a boyfriend for personal gains
P15	Female	23	Bachelor	Engaging in a dispute due to a friend's not taking sides in an important matter

After this, interviews were held with the volunteer participants who met the inclusion criteria by the two researchers via online platforms (Skype, Zoom, WhatsApp). 11 questions were asked in total (see Appendix A),

and the interviews were recorded. The recordings were kept on hard disk drives that could only be accessed by the researchers and were not connected to the internet. Both researchers have experience in qualitative interview processes. The interviews, which lasted approximately 15-20 minutes for each participant, were held between August and October 2022.

Data Analysis

The data analysis process is a cyclical and repetitive process that involves the reading of the interview transcript multiple times and the creation of codes after the achievement of familiarity with the data. In this study, the approaches of thematic analysis consisting of codes, categories, and themes (Braun & Clarke, 2019) were followed. The audio recordings of the interviews held by the two researchers with the participants were transcribed verbatim, the data were coded, categories and themes were created, and the findings were analyzed. The data were analyzed in three steps to reach the findings of the study. In the first step, all audio recordings were transcribed verbatim. Then, each transcript was examined line by line and by highlighting the parts that were especially emphasized by the participants in their responses. Afterwards, codes were placed as keywords in the leftmost column of a table consisting of four columns. In the second step, categories described by the codes were created and placed in the next column to the right, and these were reviewed multiple times. The third column was used to include quotes from the sentences used by the participants that matched the codes. In the third step, themes were created based on the codes and categories, and these were placed in the last column. This step also involved the review of data in the context of the relationships, similarities, differences, and patterns between the themes. The entire process was carried out by the two researchers, who performed the first two steps independently of each other and the third step together to make the data ready for analysis. To present the data in a more accurate and comprehensible manner, the researchers examined the differences in the coding schemes and reached a consensus in the reporting phase.

FINDINGS

In this study, where the forgiveness experiences of young adult university students were investigated, some classifications were made regarding the transgressions reported by the participants. These transgressions were categorized as ‘transgressions against one’s partner’, ‘transgressions against one’s family members’, and ‘transgressions against one’s friend’. The types of transgressions were determined as lying, violence, exploitation for own interests, ill-advised jokes, blaming, deception, humiliating family due to discipline problems, harming a living being liked by the victim, rudeness, damage to property, inappropriate expression of anger, humiliation, and neglect when being needed. The transgressions were also categorized into those that were made ‘once’ and those that were made ‘repeatedly’. As a result of the thematic analysis, four themes were reached: ‘contact process’, ‘relational responsibility/decision-making’, ‘transformative effect of being forgiven’, and ‘value of being forgiven’. The theme map showing the themes and categories regarding the experiences of perceived forgiveness is given in Figure 1 (see Appendix B). The relationships between the themes are shown with arrows in the map. The explanations of these four themes and some quotes from the responses of the participants are given below.

Theme 1: Contact Process

The participants talked about changes in their contact with the victim following a transgression they made in their interpersonal relationships. Some changes in this context were a distance between the transgressor and the victim in their relationship, the sincere approach of the transgressor and their sensitivity towards the needs of the victim, the compensatory behaviors of the transgressor, the realization of the good intentions of the transgressor by the victim, and the readiness of the victim to forgive.

The theme ‘contact process’ consisted of two categories, namely ‘attempts to reach out’ and ‘factors determining the effects of reaching out’. The participants made statements about the changes in their contact processes in their relationships with the victims after their transgressions. Among the participants, P1 stated the following:

“I mean, we used to be much closer in what we shared with each other. This decreased a lot. Although we were receiving the same education, it was like a place where we treated each other like strangers.”

P2 stated that they were more understanding toward the victim and focused on listening to them, with the words, *“Indeed, I tried to approach him [his friend] much more compassionately. That is, I tried to listen to him as much as possible. I expressed that he could share their feelings with me.”*

The participants also specified that after their transgressions, they experienced contact-related changes such as reduced communication, lower frequency of private sharing, and unkind conversations. The following was stated by P8:

"First, there appeared a substantial emotional gap between us. We started to talk less frequently. After this event, I felt that I had a smaller part in his [her brother] life. Other than that, he became a little more aggressive towards me."

The participants mentioned some factors that facilitated the contact process or made this process more difficult. The most frequently talked about facilitating factors included taking responsibility for the transgression, apologizing sincerely, being open to communication, the forgiving attitude of the victim and their strong feelings for the transgressor, the belief that the transgression will not happen again, acting in the same pace as the victim, and taking responsibility. Some of the views of the participants on the facilitating factors of forgiveness were as follows:

"I mean, I apologized, but not like… Rather than an apology like 'I apologize', I apologized by saying things like 'I was very angry and tense then, but I still shouldn't have treated you like that'. That is, if it is the wrong thing to do, it sure is." (P11)

"I am a man with a mission, meaning that I do everything to keep a promise if I've made one. As she [his friend] saw that I promised to never do that again she found it appropriate, was accepting of it, and it (the issue) was cleared up." (P10)

"The fact that I didn't pressure him [her boyfriend] was effective. You know, I didn't pressure him like let's make up right away and behave like we used to right away. We talked a bit, and we didn't put a name on the situation right away. It (the process) progressed at his pace. It was effective for me to give him space." (P14)

The most frequently mentioned barriers to forgiveness by the participants included the recurrence of the transgression, the intensity of the transgression, the deliberate nature of the transgression, the prevention of communication, the difficulty of anger management, insistence, blaming, intricacy (lack of boundaries), introversion, and unrealistic expectations. The belief of the victim that the transgression could be repeated, the negative attitudes of people around them, and social representations were also among the factors making forgiveness more difficult. The views of some participants regarding barriers to forgiveness were as follows:

"The fact that I had shown the same mistake before was among the barriers. Such that, when a thing happens once, it is forgiven more easily, but it is more difficult to forgive when it happens multiple times." (P11)

"It (forgiveness) was really made more difficult by the fact that I purposefully made this mistake or transgression, it was not something that happened by accident, it was something I did deliberately and knowingly, that is, there was my agency in the transgression." (P8)

"It was a friendship relationship in which she expected for me to provide excessive support. I mean, she was constantly demanding, I was not willing to meet these demands, or I was unable to set boundaries." (P1)

"He [her boyfriend] had concerns about whether this would happen again, or whether I had really changed. So, after a transgression, after a problem occurred, his trust was betrayed" (P14)

Theme 2: Relational Responsibility/Decision-Making

The theme 'relational responsibility/decision-making' referred to the transgressor and the victim getting closer in the forgiveness process, taking responsibility, their establishment of an understanding, the transformation of their expectations, and the determination of relationship boundaries. This theme consisted of the categories of 'responsibility of trust', 'compassionate approach', and 'reorganization of boundaries'. These categories included codes such as increased fondness, increased responsibility, self-control, transforming expectations, being understanding, determining priorities, reconciliation, and role changes.

"We became closer, more able to talk to each other about anything. […] because there used to be a problem of hiding things and lying before. We were, in fact, able to have a closer relationship when we talked about and solved the issues causing this problem." (P15)

"This showed me my humanity, and similarly, his humanity. I used to think like we are already in a romantic relationship, he had to listen to whatever I was talking about, he had to support me when I was in a difficult state, he had to bear with me unconditionally. I used to think like this. The process changed such unhealthy thoughts of mine." (P14)

"It allowed me to notice that people can get hurt or offended whatever the reason for me to do this, I should pay attention to certain things, and I should establish my priorities well." (P8)

"We are no longer as close as we used to be, for example, she [her friend] doesn't visit me at home. I don't visit her at home. We used to hang out five days a week. We aren't like that anymore; she is working anyway. I mean, we hang out once a week, sometimes twice […]. Other than that, there is a distance between us." (P15)

Theme 3: Transformative Effect of Being Forgiven

The theme 'transformative effect of being forgiven' referred to the individual changes in the transgressor after their experience of forgiveness and the changes in the attitudes of the victim towards the transgressor and other people. This theme consisted of the categories of 'awareness' and 'biopsychosocial development'. The codes under these categories included the concepts of noticing the maturity of the victim, noticing that people can be hurt, understanding the value and resilience of the relationship, self-awareness, awareness of personal characteristics, differences in coping styles, differences in criteria for forgiveness, and understanding the importance of boundaries.

"I mean, I used to think she [his sister] wasn't that mature, but I then noticed how mature she actually was, because forgiving is a very difficult act." (P6)

"In general, I noticed some things including how much this person valued me. She [her friend] didn't have to forgive me. That is, the bond between us wasn't something that could be taken lightly, it was something that needed more care." (P3)

"In fact, it made me notice the patterns I was repeating in my life, not just about this relationship, but I became aware that I had a tendency to avoid relationships that suffocate me in many areas of my life." (P1)

"One doesn't really feel forgiven, without talking about what the problem actually is, what the parties feel in detail, thoroughly. So, I have come to believe that one needs to be sincere in the process of being forgiven by someone." (P8)

The participants explained the transformations they felt in their experiences of forgiveness under the category of biopsychosocial development. The most frequently encountered transformations included getting to approach the victim and other individuals with more positive attitudes, the transformation of physical indicators, having a forgiving stance, self-compassion, flexibility in the demand for forgiveness, the development of empathy, and the development of trust. Some participants mentioned feelings of weakness and embarrassment in the first stages following their experience of forgiveness, but it was emphasized these feelings were not long-lasting.

"I tried to have self-regulation in my behaviors and such, because I sit down and question it. Even if I want to do something, I question why." (P10)

"After this, compared to before, I'm now more flexible in terms of accepting my fault and asking for forgiveness or embracing someone if they do the same to me or are in the same position for my future relationships, family relationships, friendships, etc., even though this doesn't work out." (P14)

"I had physical discomfort, including serious problems in my stomach and bowels due to the unilateral relationship and this transgression […]. I overcame these problems thanks to the comfort I got from being forgiven." (P9)

"As that burden started to lift up, as I saw him [his friend] me, it became easier for me to forgive myself." (P2)

"When I recognized the experience of forgiveness as a more humane concept and understood that it is a part of the human experience, I accepted it as an experience, and I thought I was happier by looking at it more positively." (P13)

"*In the beginning, that change took a lot of time. After that, the bond of trust between us became more strong." (P4)*

"Being forgiven is a good experience, but I can say that struggling for this, being influenced a lot by what that person [her friend] says, etc. in fact, made me feel weak a little bit. I mean, I could say the experience itself made me feel weak, but as I said, I felt empowered at the end." (P8)

Theme 4: Value of Being Forgiven

Based on the statements of the participants, the theme of "value of being forgiven" consisted of the categories of 'relationship as a source of power', 'understanding the resilience of the relationship', 'not leaving any hurt', and 'common past'. In the scope of these categories, the included concepts were about the value of the victim, secondary gains, less avoidance, being comforted by the request for forgiveness, and positive contributions to self.

"I had secondary gains from the relationship. I mean, he [her father] provided me with things. He would take me places then or pick me up from work." (P11)

"I understood that taking steps to be forgiven, apologizing for example, is not something that would degrade me, or I understood that it isn't something that would allow the other person to have dominance over me. It is simple, actually. I understood that it is something that needs to be done by any transgressor or anyone who expects forgiveness." (P15)

"You know, I think he [his friend] is a good person. It was highly valuable for me to see that I hadn't left any unpleasant effect on him." (P2)

"They (the past experiences) earn a significant place in a person's life. I mean, an effort can be made anyway, but more effort can be made for such a person." (P12).

DISCUSSION & CONCLUSION

As a result of this study, which was conducted to explore the experiences of young adult university students regarding being forgiven after their transgressions, the overarching themes of 'contact process', 'relational responsibility/decision-making', 'transformative effect of being forgiven', and 'value of being forgiven' were obtained.

In the first phases of the forgiveness process, the participants developed an awareness of their fault and empathized with the victim in terms of the effects of the transgression on the victim. In the model they developed to explain forgiveness experiences in interpersonal relationships, Enright et al. (1996) stated that transgressors first notice the effects of their transgressions on the victims, and they experience the outcomes of their transgressions.

In this study, it was understood that the participants experienced some negative changes due to their transgressions such as barriers to communication in their relationships with the victims of their transgressions, the unhealthy expression of anger, and growing apart. It was seen that to repair their relationships with the victim, the participants expressed the guilt about mistake, and through these feelings of guilt, they showed a motivation to make up for their mistakes, become closer again in their relationship with the victim, and strengthen their relationship again. The feeling of guilt leads individuals to perform behaviors such as making up for their negative behaviors, having regret, and apologizing (Hall & Fincham, 2005; Tangney, 1991). McCullough, Worthington and Rachal (1997) reported that compensatory behaviors following a transgression increase the forgiving characteristics of the victim by improving their empathy levels. Similarly, Knight (2018) found that the perceived forgiveness level of the transgressor was positively associated with the appeasement/positivity communication style, which corresponds to compensatory behaviors for the alleviation of the effects of the transgression and the appeasement of the victim, and the apology/concession communication style, which corresponds to privileges for the victim, the acceptance of a mistake, and apology.

The participants reported some factors that facilitated their forgiveness processes. These factors included agreeableness, open communication, and sincere compensation. Some studies in the relevant literature have provided results supportive of those in this study. In their sample of university students, Knight (2018) revealed that the avoidance/silence communication style, which is characterized by the avoidance of communicating in relation to the transgression, was negatively associated with perceived forgiveness. In a study in which the relationships between 5-factor personality traits and perceived forgiveness were investigated in university students, similarly, agreeableness was found to have a positive relationship to perceived forgiveness (Walker & Gorsuch, 2002). Additionally, the participants talked about some facilitating factors regarding the acceptance of the transformation of the victim in the forgiveness process with insightfulness such as giving the victim some space and progressing at the pace of the victim. Likewise, in the process model they developed regarding the concept of receiving forgiveness, Enright et al. (1996) argued that in the forgiveness process, the transgressor anticipates the transformation of the victim humbly. In addition, the participants listed some factors that made the forgiveness process more difficult as the recurrence and intensity of the transgression, the deliberate nature of the transgression, the prevention of communication, the difficulty of anger management, insistence, blaming, intricacy (lack of boundaries), the negative attitudes of people around them, and unrealistic expectations. Some studies have revealed that the characteristics of a transgression have significant outcomes in the forgiveness process (Hall & Fincham, 2008; Taysi, 2007; Vangelisti & Young, 2000). However, it can be asserted that there is a limited number of studies addressing the factors that positively or negatively influence the process of forgiveness. This indicates a need for further research in this field to comprehensively understand the elements that impact the process of forgiveness.

In this study, the participants stated that the forgiveness process brings about a reconciliation in terms of the reorganization of relationship boundaries and roles. In the case of reconciliation, decisions are made regarding several issues associated with relationship boundaries such as making up or growing apart in the relationship between the transgressor and the victim, as well as the transformation of relational roles and expectations. Some researchers have reported the presence of reconciliation between the victim and the transgressor along with forgiveness (Everett & Worthington, 2005; Gassin, 1998; Swink & Leveille, 1986). Considering the responses of the participants of this study, it may be thought that reconciliation is a part of the forgiveness process, and it emerges as a consequence of forgiveness. However, although reconciliation is seen in a relational sense in the process of forgiveness, it does not always mean that forgiveness takes place. In addition to its relational aspect, forgiveness also has an intrapsychic nature. Moreover, the reconciliation that is seen in interpersonal relationships might not reflect an emotional transformation towards forgiveness.

The participants of this study reported that they showed many positive individual changes following their forgiveness. Such changes included a reduction in negative emotions and stress levels, the development of self-awareness and awareness regarding forgiveness, an increase in positive emotions such as trust and empathy, feeling negative emotions in the first stage. In the context of emotional transformations, reductions in negative emotions such as guilt, anger, and sorrow were frequently reported. Such transformations bring relief in the emotional sense. Likewise, several studies have indicated that there is a reduction in the negative emotions of transgressors when they are forgiven (Gassin, 1998; Krause & Ellison, 2003; vanOyen-Witvliet et al., 2002; Zechmeister & Romero, 2002). It was also seen that the transgressors developed a more compassionate approach towards themselves after their experiences of being forgiven, and it became easier for them to forgive themselves for these transgressions. This result was compatible with the results of previous studies showing a positive relationship between the experience of being forgiven and self-forgiveness (Gassin, 1998; Hall & Fincham, 2008; Ingersoll – Dayton et al., 2010; Rahman, 2013; Terzino, 2010). Consistently, in the study in which they examined forgiveness between married couples, Fliesen et al. (2005) found that the perceived forgiveness levels of the partner were negatively associated with self-blame and positively associated with self-forgiveness. It may be considered that along with being forgiven, it becomes easier for transgressors to forgive themselves by their more positive self-evaluation. Being forgiven may reduce the negative self-evaluation of the transgressor and bring about positive psychological outcomes such as relief and comfort (Ingersoll-Dayton et al., 2005).

In this study, some participants mentioned the development of self-awareness after their forgiveness experiences. The participants stated that they experienced changes such as their awareness of responsibility, their awareness of the ill intent causing the transgression, their awareness of the consequences of their behaviors, and changes in relationship patterns, personality patterns, and coping styles. In agreement with this result, Gassin (1998) found that their participants reported changes such as accepting that they could be at fault, noticing their responsibilities, and recognizing the effects of own behaviors on other people. After forgiveness, there were also some changes in the awareness of the participants towards others. These changes included seeing the maturity of the victim, understanding that people can be hurt, and recognizing forgiving people around oneself. In their study on the effects of being forgiven, Gassin concluded that the participants found others more forgiving after their own experiences of being forgiven. In this study, the participants stated that they noticed their value and the value of their relationship for the victim better. In agreement with this, Gassin stated that in the process of forgiving the transgressor, the victim expressed messages such as ‘you are valued’ and ‘our relationship is valuable for me’.

Some of the participants of this study mentioned some negative emotions that were short-lived for them after their forgiveness, including weakness and embarrassment. There are studies in the literature that support this result. The forgiveness of the transgressor by the victim may be considered prosocial behavior. Fisher et al. (1982) emphasized some conditions in which negative responses to exposure to prosocial behavior, such as the negative evaluation of the person showing the prosocial behavior and experiencing decreases in self-confidence, could be encountered. Droll (1984) stated that perceived forgiveness results in some outcomes such as feeling indebted to the person who forgives and considering oneself in a lower status than them.

In this study, it was understood that after being forgiven, the participants experienced positive changes not only in their relationships with the victim but also in their relationships with other people. It may be argued that among these changes, noticing the maturity of the victim, making a behavioral effort to avoid hurting the victim again, taking relational responsibilities, and treating others in a more forgiving and compassionate matter are significant changes that will contribute to interpersonal functionality levels. In line with these results, Wallace et al. (2008) stated that the perception of forgiveness by individuals provides improvements in their interpersonal functionality levels.

In this study, some participants reported that they started to trust the victim and their relationship more after being forgiven. Gassin (1998) determined that transgressors felt safer in their relationship with the victim after being forgiven by them. In their sample of married university students, Wieselquist (2009) identified positive relationships between the perception of the spouse as a forgiving person and the trust felt towards the spouse. The development of the feeling of empathy was also among the important changes following the experience of being forgiven among the participants of this study. Most participants reported the development of empathy towards the victim both during and after the forgiveness process. In their model explaining the process of forgiveness, Enright et al. (1996) specified a stage in which the transgressor develops empathy for the victim.

Some participants mentioned that they started to have more compassionate and forgiving attitudes toward the victim and other people after their forgiveness by the victim. Similarly, in their study that was carried out to investigate the experiences of transgressors in interpersonal relationships, Gassin (1998) found that after being forgiven, the participants learned more about forgiving and showing unconditional love for others. Ingersoll-Dayton et al. (2010) found a positive relationship between perceived forgiveness and forgiving others. Hayward and Krause (2013), who examined the experience of perceived forgiveness in two cohorts, determined a positive relationship between the participants' feelings of being forgiven and their forgiveness of others. Based on this information, it may be concluded that being forgiven has several positive relational effects on the individual.

The vast majority of the participants in this study talked about changes after their forgiveness such as noticing their responsibilities in their relationship with the victim and showing behavioral effort to not hurt the victim again. Previous studies have also shown that significant proportions of transgressors who reported relational transgressions showed care to not to hurt the other party again after feeling forgiven by them (Gassin, 1998; Wallace et al., 2008). Accordingly, it may be expected that perceived forgiveness will result in positive behavioral changes.

Regarding the importance of being forgiven by one's victim, the participants of this study mentioned some situations such as relational gains, the value and resilience of the relationship, the consideration of the process as an experience, and not leaving the victim hurt. The literature review that was conducted for this study did not reveal any previous study that included the views of individuals on the importance of the concept of being forgiven. Gassin (1998) claimed that topics related to the forgiveness process like apologizing, accepting mistakes, and asking for forgiveness could be discussed at school, and they could be utilized as a part of ethics education. It may be considered that these practices could make the forgiveness process of transgressors easier. However, the perceptions of individuals regarding forgiveness and their attitudes towards the value of being forgiven may determine the extent to which they can utilize such practices. The attitudes of individuals towards the concept of being forgiven may influence their levels of motivation in issues that are among the important components of the forgiveness process such as noticing the transgression, empathizing with the victim, taking responsibility, making up for the transgression, and asking forgiveness from the victim.

Strength, Limitations, and Recommendations

Forgiveness has usually been studied from the perspective of the victim. On the other hand, the experiences of transgressor were the focus of this study. In addition, it is seen that most studies on forgiveness have been carried out using quantitative research methods. In this study, with the help of a qualitative research design, the experiences of the participants in the forgiveness process were uncovered from a qualitative in-depth perspective.

Conducting future studies by focusing on the experiences of transgressors in their processes of being forgiven will be beneficial in terms of increasing the limited literature on this topic. In this study, it was determined that factors such as the repetition of the transgression, its deliberate nature, and its intensity were also important in the forgiveness process. The effects of the characteristics of transgressions on the forgiveness process can be examined in more detail in future studies. The data of this study were collected from university students between the ages of 21 and 30. Further studies to be performed with individuals in different age groups may allow a broader understanding of the dynamics of forgiveness process. The experience of being forgiven could also be investigated in the context of transgressions that are very difficult to atone for or those that are impossible to resolve. The increased intensity of the transgression and the impossibility of its resolution may affect the experiences of transgressors substantially. This study was carried out using data obtained from qualitative interviews. Future studies could utilize multiple data sources using different methodologies.

Statements of Publication Ethics

Ethics approval was obtained from the Scientific Research and Publications Ethics Committee of Kahramanmaras Istiklal University (25.07.2022-2022/03). The authors of this article declare that this research has not any ethical conflicts or problems that may limit the publication of the article.

Researchers' Contribution Rate

The authors equally contributed to this study.

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Ramazan	☒	☒	☒	☒	☒	☒
Zerrin	☒	☒	☒	☒	☒	☒

Conflict of Interest

The authors have no conflicts of interest to disclose.

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Challenging Life Events Indications Scale: Validity and Reliability

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Abstract

The main purpose of the current study was to develop a valid and a reliable measurement tool, Challenging Life Events Indications Scale (CLEIS), for the measurement of adults' reactions to challenging life events. The study was carried out with four different samples/research groups. The data were analyzed using exploratory and confirmatory factor, and ROC analyses via IBM SPSS and SPSS AMOS 24®. The factor loadings and corrected item-total correlations were found to be above the acceptable level, and the variance explained was 62.95%. The scale was observed to have a three-factor structure with an eigenvalue greater than 1, and fit indices of the relevant structure were at acceptable levels. According to the ROC analysis, the cut-off score of the CLEIS was found to be 78.5 for people needing psychological support after a challenging life event. In addition, the sensitivity of the tool was found to be able to discriminate people who showed symptoms of a challenging life event with a probability of 0.527. When analysing the specificity of the measure, it was found that the scale was able to identify people who showed symptoms of difficult life events with a probability of 0. 050. The criterion validity of the scale was examined through the Perceived Stress Scale, and the results produced a correlation of .72 between CLEIS and perceived stress, and .46 between perceived coping and CLEIS. Overall Cronbach's alpha was found to be .96. The scale was found to be a valid and a reliable tool. The findings were discussed within the related literature and suggestions were made accordingly.

Keywords: Challenging life events, psychological support, adaptation disorders

Zorlayıcı Yaşam Olayları Göstergeleri Ölçeği: Geçerlik ve Güvenirlik

Öz

Bu çalışmanın temel amacı, yetişkin bireylerin zorlu yaşam olaylarına yönelik vermiş oldukları tepkileri belirlemek için geçerliği ve güvenirliği sağlanmış olan bir ölçme aracı geliştirmektir. Bu araştırma bir ölçek geliştirme çalışmasıdır. Araştırma dört farklı çalışma grubu ile yürütülmüştür. Ulaşılan verilerin analizinde açımlayıcı, doğrulayıcı faktör analizi ve ROC analizi kullanılmıştır. Araştırmanın analizleri SPSS ve AMOS programları ile yapılmıştır. ZYOBÖ ölçme aracının maddelerinin faktör yükleri ve düzeltilmiş madde toplam korelasyonlarının kabul edilebilir seviyenin üstünde olduğu, ölçme aracının açıkladığı varyansın % 62.95 olduğu tespit edilmiştir. Ölçme aracının özdeğerinin 1'den büyük olduğu üç faktörlü bir yapıya sahip olduğu anlaşılmış olup, ilgili yapının uyum iyiliği değerlerinin kabul edilebilir seviyede olduğu anlaşılmıştır. ROC analizine göre ise, zorlu yaşam olayı sonrasında psikolojik desteğe ihtiyaç duyan kişiler için ZYOBÖ kesme puanı 78.5 olduğu, ölçme aracının duyarlığının 0.527 olasılıkla zorlu yaşam belirtisini gösteren kişileri ayırt edebildiğini ve özgünlük değeri ise 0.050 olasılıkla gerçek durumda zorlu yaşam olayları belirtisi gösteren kişileri belirleyebildiği anlaşılmıştır. Ölçme aracının ölçüt geçerliği ise, Algılanan Stres Ölçeği ile incelenmiş, sonuçlar ZYOBÖ ile algılanan stres arasında .72, algılanan baş etme arasında .46 ilişkili olduğunu ortaya koymuştur. Güvenirlik katsayısının ise, ölçeğin tümü için .96 olduğu bulunmuştur. Bu veriler ışığında Zorlu Yaşam Olayları Belirti Ölçeği'nin geçerli ve güvenilir bir ölçme aracı olduğunu ortaya koyulmuştur. Ulaşılan bulgular alanyazın bağlamında tartışılmış, önerilerde bulunulmuştur.

Anahtar Sözcükler: Zorlayıcı yaşam olayları, psikolojik destek, uyum bozuklukları

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INTRODUCTION

Challenging life events emerged as a result of a number of reasons such as wars and security problems in the history of communities and their impacts appeared in the forms of daily life hardships and adaptation disorders (Özen, 2017). Today, challenging life events or trauma are becoming threats that the societies and institutions have to face directly or indirectly.

DSM V (2013) identifies trauma or destructive events as facing death, serious injury or sexual abuse. Traumatic events may create destructive impacts on individuals' behavior systems that form a sense of attachment, control and meaning. Most people may suffer traumas distinctively, which are caused by events occurring at a time or in a sequence (Herman, 2019). According to DSM V (2013), individuals suffering trauma may develop reactive attachment disorder, disinhibited social engagement disorder, acute stress disorder, post-traumatic stress disorder, and adaptation disorder. Of these, acute stress disorder is the sort of disorder in which nine or more symptomatic behaviors including dissociation, negative affect, avoidance and sensitivity, which develop or exacerbate after the first three days or within one month of the traumatic event, are observed. Post-traumatic stress disorder indicates the re-experience of the event in sustained vivid flashbacks, refrainment from the destructive event, negative attitude towards the experience, and specific alterations in impulsive reactions which emerge after or with the event. However, the literature shows studies on post-traumatic stress disorder, even if sufferers are not life-threatened or their personal boundaries are not assaulted. For example, Dreman (1991) found that divorcing was a traumatic experience and that the divorced parents' defensive behaviors were similar to of those suffering post-traumatic stress disorder. In EMDR therapy, experiences which are defined as minor "t" traumas, which occur in early ages and do not threaten life safety but may have negative impacts emotionally, are observed to have impacts on mental health as much as major traumas do (Mol, Arntz, Metsemakers, Dinant, Vilters-van Montfort, & Knottnerus, 2005; Wong, 2018). In addition, minor "t" traumas are addressed as micro-traumas in positive psychology and they stem from conflicts and from moments of negligence in early ages (Cope, 2014; Trans. Yılmaz-Dinç & Sapmaz, 2022).

There are two basic views on PTSD: (a) an alteration in behavior after the traumatic event and (b) a person's liability before the traumatic event. However, it is stressors which have direct effect on whether the event will be traumatic for the individual or not (Breslau, Davis, Andreski, Peterson, & Schultz, 1997). Also, various factors including race, culture, mentality, socio-economic level, marital status (divorced, separated etc.) and heredity have crucial roles on whether the person will suffer trauma or not (Cervatoğlu-Geyran, 2000; Mason, Giller, Kosten, Ostroff & Podd, 1986). Besides these, the sufferer may develop some cognitive, emotional, and behavioral reactions such as anxiety, insomnia, vigilance, increased blood pressure, sweating, trembling, muscle stress, learned helplessness, avoidance, feelings of isolation, worthlessness and insecurity towards the world, and regarding people as unhelpful (Breslau, Davis, Andreski, Peterson, & Schultz, 1997; Cervatoğlu-Geyran, 1995; Southwick, Morgan, Darnell, Bremner, Nicolaou, Nagy, & Charney, 1995; Sungur, 1999). The study by Ramsay (1990) showed that soldiers who went into the American Civil War displayed negative reactions both physically and mentally (dizziness, chest pain, palpitations etc.). The study by Volkan (2000) revealed that fathers who were badly treated during the invasion tended to hide it from their children -if the children did not witness it and unwittingly stayed away from emotional interaction with their children. Moreover, adults asked their children to keep the negative events in schools during the invasion as a secret when they went back to school and that this led to psychological problems in children.

Particularly with the increase of social media use, people all around the world now have the chance to be informed about recent climate crises, civil and international wars, pandemics etc., meaning that individuals may negatively be affected by events, both directly or indirectly. According to Güran-Yiğitbaşı (2016), social media users mostly witness the sufferings of war victims. A study done in pandemics period, some of the participants displayed negative cognitive and affective reactions basing on what they learnt about COVID-19 even before they caught it (Aldemir, Yanar, Aydoğmuş & Şenel, 2021). Considering the factors of PTSD, witnessing what causes trauma and re-experiencing the details of the destructive event, those who indirectly witness traumatic experiences through social media and blog sites may be said to potentially develop symptoms of PTSD.

Taken altogether, studies aiming to increase the life quality of those who display symptoms of PTSD in intellectual, emotional, behavioral and physiological aspects are needed. However, the literature shows, as far as is known, studies which intervene trauma cases through interviewing or group therapies (Altun, 2016; Çiller, Köskün, & Akça, 2022). Hence, the purpose of the current study is to measure the evidence-based levels of PTSD

symptoms of the participants. Following this, the impacts of these symptoms are to be specified and re-framed and intervened through individual or group therapies. This scale development is expected to increase the quality of counseling services in schools or mental health centers and the efficiency of critical intervention.

METHOD

Design

The current study is of quantitative research which is for examining correlations among variables and testing objective theories. The measurement of these correlations is usually provided with scales, questionnaires etc. Raw data transformed accordingly are analyzed through statistical calculations (Creswell, 2014).

Participants

Sample I

For the exploratory factor analysis, 748 participants (410 females, 54,8%; 338 males, 45,2%) were selected with convenient sampling. They ranged in age from 20 to 65 ($\overline{X}$ = 38.9, SS= 8.9).

Sample II

For the confirmatory factor analysis, 245 participants (124 females, 50,6%; 121 males, 49,4%), ranging in age from 21 to 65 ($\overline{X}$ = 38.2, SS= 8.8) were selected with convenient sampling

Sample III

For the criterion-related validity, 372 participants (257 females, 69,1%; 115 males, 30,9%) ranging in age from 20 to 64, were selected with convenient sampling ($\overline{X}$ = 31.6, SS= 6.4).

Sample IV

For the ROC analysis, 310 participants (169 females, 54,5%; 141 males, 45,5%), ranging in age from 18 to 64, were selected with convenient sampling ($\overline{X}$ = 36.4, SS= 9.9).

Data Collection Tools

Developing Challenging Life Events Indications Scale (CLEIS)

The initial step was to specify the structure to be measured. The literature was reviewed and the related studies were examined to help create an item pool which was consisted of 52 items in total. The items were related, clear and plain, and not to be ambiguous. The scale was formed as 5-Likert type (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Five experts in psychology were asked to examine the scale to ensure its relatedness, reliability, validity, comprehensibility, and specificity. A draft form for content validity was formed and presented to the experts through the electronic media. Considering the feedback from the experts, the suggestions and evaluations of the items were discussed and the scale was finalized with 52 items after making the required corrections in the draft form.

Perceived Stress Scale (PSS):

Originally developed by Cohen, Kamarck and Mermelstein (1983), the Perceived Stress Scale was adapted to Turkish by Bilge, Öğce, Ekti-Genç and Tuna-Oran (2009). The adaptation practice was performed with 162 participants (83 undergraduates and 79 employees). Exploratory factor analysis extracted a two-factor PSS structure: perceived stress and perceived coping. The Cronbach's alpha for the eight-item form was reported .81, and it was .84 for perceived stress dimension, and .69 for perceived coping. Item reliability analyses yielded .70 Cronbach's alpha, .082 Guttman split-half, and .082 Spearman-Brown.

Personal Information Form (PIF):

A personal information form was developed for demographic information (i.e., age, sex).

Data analysis

Exploratory and confirmatory factor analyses were performed for validity. For the exploratory analysis, rotation method was employed, and for the confirmatory analysis, modification indices were considered to get a better fit. For the confirmation of the three-factor structure, the fact that significance of *t* and that fit indices should be at least at the acceptable level were considered. Pearson's correlation analysis was performed for the criterion validity, and reliability was analyzed using bivariate correlation method. All reliability and validity analyses were performed using JAMOVI, SPSS 22.0 and SPSS AMOS 22.0®.

FINDINGS

Structure validity

Scale validity was examined with exploratory and confirmatory factor analyses. Promax rotation was run to examine the factor structure. For the interpretation of the factor analysis, Kaiser-Mayer Olkin and Bartlett's spherity tests results were considered. Normality was examined also using Bartlett's spherity. Criteria for determining the items were as follows: (a) factor loadings should be at least .30 or upper, (b) the items should gather to create a single factor, (c) there should be no overlapping items (variance should not be lower than .15), (d) a single factor should be comprised of at least three items, and (e) corrected-item total correlation coefficient should be over .20 (Şencan, 2005).

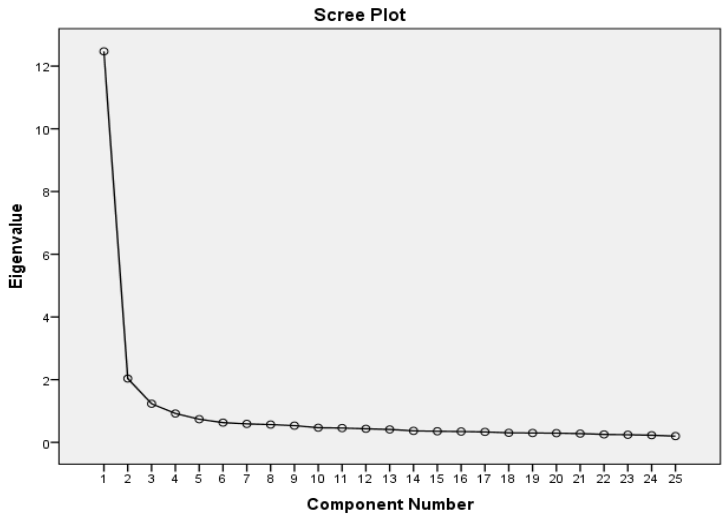
Exploratory factor analysis

Exploratory factor analysis was performed to reveal the inter-item communalities. The initial analysis yielded .96 KMO. KMO test is for determining if partial correlations are low or not, and if normality is adequate for exploratory factor analysis (Karagöz & Kösterelioğlu, 2008). Tavşancıl (2010) notes that KMO is considered perfect if it is close to 1, and unacceptable if it is lower than .50. KMO for the current study data is therefore acceptable. Bartlett's spherity test was 1.570 (p< .001). The significance of Bartlett's spherity test supports the hypothesis that the data consisted of multi-variant normality.

EFA was performed with no limits on the number of factors and seven factors of which eigenvalues were larger than 1 were specified. Total variance explained was 63,04%. The factor distribution was examined using varimax rotation and some of the items were observed as outliers (> .30). Varimax is a rotation method that minimizes the number of variables that have high loadings on each factor. This method was preferred because it makes it easier to interpret the factors. Accordingly, factor loading values were analyzed and the items which had a variance lower than .15 were eliminated (Büyüköztürk, 2012). Consequently, 27 items were removed and the analysis was re-run.

The re-run analysis yielded that all items gathered under three factors larger than 1 and that each factor had acceptable loadings (the lowest was .60; the largest was .82). Also, no outliers in more than one factor were observed. The eigenvalues ranged from 1.23 to 12.47. Total variance explained of the three-factor structure was 62,95%. Büyüköztürk (2012) states that the higher the variance explained is, the stronger the factor structure will be. In social sciences and the humanities, it is regarded difficult to achieve higher degrees of variances and they are accepted adequate in the range of 40% and 60% (Tavşancıl, 2010). These results corroborated that the total variance of the scale is on the expected level. Figure 1 displays factor structure scree plot.

Figure 1. Factor structure scree plot



As seen in Figure 1, the scale extracted a three-factor structure, namely emotional reactance, cognitive reactance and physiological reactance, of which eigenvalue was larger than 1. The emotional factor was comprised of eight items, the cognitive factor consisted of seven items, and the physiological factor included 10 items. Table 1 displays the factor loadings, item discrimination, and corrected-item correlations.

Tablo 1. Factor loadings, corrected-item total correlations and item discrimination

Factor (Total variance explained)	Item number	Factor loadings	Corrected-item total correlations	Item discrimination *
Physiological reactance (12.47%)	m16	.66	.59	.000
	m17	.69	.69	.000
	m18	.63	.73	.000
	m19	.72	.59	.000
	m20	.73	.62	.000
	m21	.68	.56	.000
	m22	.74	.65	.000
	m23	.64	.49	.000
	m24	.77	.64	.000
	m25	.75	.51	.000
Emotional reactance (2.03%)	m1	.82	.69	.000
	m2	.76	.67	.000
	m3	.73	.53	.000
	m4	.60	.53	.000
	m5	.65	.60	.000
	m6	.63	.67	.000
	m7	.68	.60	.000
	m8	.67	.70	.000
Cognitive reactance (1.23%)	m9	.66	.62	.000
	m10	.71	.62	.000
	m11	.67	.57	.000
	m12	.74	.65	.000
	m13	.61	.65	.000
	m14	.62	.63	.000
	m15	.62	.43	.000

* $p<.05$, n= 748

Table 1 shows the factor loadings, item discriminant values, and corrected item-total correlations indicating that the scale has a three-factor structure, the items carry acceptable loadings, and the corrected item-total correlations vary between .43 and .73. Additionally, no outliers in multiple factors were encountered.

Confirmatory factor analysis

The number of participants in the confirmation of a scale structure is a crucial factor to consider. The literature suggests that for the development of Likert-type scales, a sample size of at least five or ten times the number of items in the scale should be reached (Tavşancıl, 2010). Accordingly, particular attention was paid to ensuring that the number of participants in the study was at least five times the number of items in the instrument. According to confirmatory factor analysis (CFA), latent variables were validated under a three-factor structure, and the *t*-values were found to be significant (p <.05). The model incorporates goodness-of-fit indices related to model acceptability. For goodness-of-fit values, the following criteria were considered: $\chi 2/df \leq 4\text{-}5$, IFI ≤ .95, CFI

≤ .95, AGFI ≥ .80, NFI ≥ .80, SRMR ≤ .08, RMSEA ≤ .10, PNFI ≤ .95, RMR ≤ .08, and PGFI ≤ .95 (Baumgartner & Homburg, 1996; Bentler, 1980; Bentler & Bonett, 1980; Browne & Cudeck, 1993; Hu & Bentler, 1999; Kline, 2011; Marsh, Balla & McDonald, 1988; Marsh, Hau, Artelt, Baumert, & Peschar, 2006). CFA results are displayed in Table 2 regarding the mentioned criteria. Figure 1 displays the three-factor structure of CLEIS (ER: Emotional Reactance, CR: Cognitive Reactance, PR: Physiological Reactance).

Table 2. Fit indices for the measurement model

Fit indices[1]	Scores	Notes
χ^2/sd	2.24*	Perfect fit
CFI	.92	Acceptable fit
IFI	.92	Acceptable fit
RMSEA	.07	Acceptable fit
SRMR	.04	Acceptable fit
RMR	.06	Acceptable fit
PNFI	.77	Acceptable fit
PGFI	.68	Acceptable fit
AGFI	.80	Acceptable fit
NFI	.86	Acceptable fit

* χ2= 601.773, *sd*= 268, *p*<.001

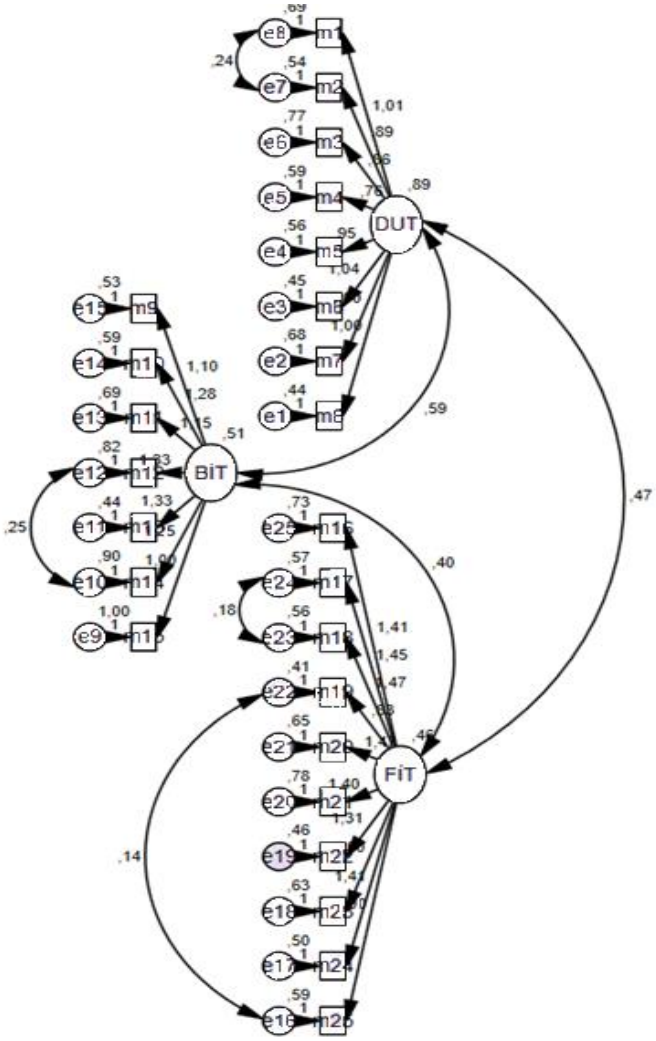


Figure 1.

Criterion-based validity

The two subscales of the Perceived Stress Scale (perceived stress, perceived coping) were utilized to establish criterion-related validity. The analysis was conducted using Pearson's correlation.

Table 3. Pearson's correlation content-based validity

	CLEIS-Total	Perceived Stress	Perceived Coping
CLEIS-Total	1		
Perceived Stress	.72**	1	
Perceived Coping	.46**	.40**	1

***p*<.01

Table 3 displays the Pearson's correlation analysis conducted for criterion-related validity. The criterion-related validity of the measurement instrument was assessed in relation to the two factors of the Perceived Stress Scale. The results revealed a significant positive relationship between CLEIS and perceived stress at a level of .72, and between CLEIS and perceived coping at a level of .46 ($p < .01$).

Validity and reliability

The term "validity" refers to the ability of a measurement instrument to accurately capture the intended construct, producing consistent results when applied across different time periods, locations, and participant groups (Şencan, 2005). The criterion mentioned as internal consistency in relation to reliability is based on the understanding that all items in the measurement tool measure the same attribute (Tavşancıl, 2010). In order to determine the internal consistency in Likert-type measurement tools, item analyses are conducted and Cronbach's alpha coefficient is obtained (Özdamar, 1999). The general consensus is that Cronbach's alpha coefficient should be at least .70 (Kılıç, 2016; Özdamar, 1999). The overall reliability was determined using Cronbach's alpha and McDonald's omega coefficient, and it was found .96. For the sub-scales, the Cronbach's alpha and McDonald's omega coefficients were found to be .91; for the emotional reactance dimension, .88 for the cognitive response reactance, and .92 for the physiological reactance dimension, respectively. Test-retest reliability was conducted with a two-week interval, and a reliability coefficient of .86 was obtained for the overall CLEIS.

ROC analysis and cut-off score

ROC analysis was conducted to calculate the cut-off score for determining whether individuals needed psychological support. Table 4 presents numbers and percentages regarding the participants' need for psychological support.

Table 4. Participant distribution according to need for psychological support (NPS)

Sample	N	%
Group positive (NPS diagnose = 1)	91	39.5
Group negative (NPS diagnose = 0)	219	60.5
Sample size	310	100

As observed, 39.5% (n = 91) of the participants stated "I need psychological support" while 60.5% (n = 219) stated "I do not need psychological support."

Table 5 displays ROC analysis cut-off scores for CLEIS regarding if the participants needed psychological support or not.

Table 5. CLEIS ROC analysis results

Cut-off score	Sensitivity	1- Specificity	Likelihood

24,0000	1,000	1,000	1
25,5000	1,000	,968	1,033019
26,5000	1,000	,963	1,037915
27,5000	1,000	,959	1,042857
28,5000	1,000	,950	1,052885
29,5000	1,000	,922	1,084158
30,5000	1,000	,909	1,100503
32,0000	1,000	,904	1,106061
33,5000	1,000	,900	1,111675
34,5000	1,000	,890	1,123077
35,5000	1,000	,881	1,134715
36,5000	1,000	,868	1,152632
37,5000	1,000	,863	1,15873
38,5000	1,000	,854	1,171123
39,5000	1,000	,836	1,196721
40,5000	1,000	,822	1,216667
41,5000	1,000	,817	1,223464
42,5000	1,000	,795	1,258621
43,5000	1,000	,772	1,295858
44,5000	1,000	,763	1,311377
45,5000	1,000	,740	1,351852
46,5000	1,000	,731	1,36875
47,5000	1,000	,712	1,403846
48,5000	1,000	,689	1,450331
49,5000	1,000	,662	1,510345
50,5000	1,000	,635	1,57554
51,5000	,978	,589	1,660363
52,5000	,967	,566	1,707905
53,5000	,945	,521	1,8155
54,5000	,945	,507	1,864568
55,5000	,934	,461	2,025351
56,5000	,923	,438	2,105769
57,5000	,901	,402	2,242507
58,5000	,901	,393	2,294659
59,5000	,890	,342	2,599121
60,5000	,890	,324	2,74555
61,5000	,890	,306	2,909464
62,5000	,879	,297	2,961961
63,5000	,868	,274	3,168681
64,5000	,868	,265	3,277946
65,5000	,857	,256	3,352041
66,5000	,835	,247	3,387057
67,5000	,824	,224	3,683561
68,5000	,802	,205	3,904029
69,5000	,780	,192	4,068289

70,5000	,769	,183	4,211538
71,5000	,714	,155	4,60084
72,5000	,692	,146	4,737981
73,5000	,670	,128	5,242936
74,5000	,626	,128	4,899137
75,5000	,582	,100	5,797702
76,5000	,571	,078	7,361345
77,5000	,549	,059	9,256128
78,5000	,527	,050	10,5015
79,5000	,505	,041	12,30037
80,5000	,495	,032	15,47096
81,5000	,462	,023	20,21538
82,5000	,451	,009	49,33516
83,5000	,429	,005	93,85714
84,5000	,396	,000	#SAYI/0!
85,5000	,374	,000	#SAYI/0!
86,5000	,352	,000	#SAYI/0!
88,0000	,330	,000	#SAYI/0!
90,0000	,308	,000	#SAYI/0!
91,5000	,253	,000	#SAYI/0!
92,5000	,220	,000	#SAYI/0!
93,5000	,209	,000	#SAYI/0!
94,5000	,165	,000	#SAYI/0!
95,5000	,132	,000	#SAYI/0!
96,5000	,110	,000	#SAYI/0!
99,0000	,099	,000	#SAYI/0!
101,5000	,088	,000	#SAYI/0!
103,0000	,077	,000	#SAYI/0!
105,0000	,066	,000	#SAYI/0!
108,0000	,055	,000	#SAYI/0!
113,0000	,044	,000	#SAYI/0!
117,0000	,033	,000	#SAYI/0!
119,0000	,022	,000	#SAYI/0!
120,5000	,011	,000	#SAYI/0!
122,0000	,000	,000	#SAYI/0!

Table 5 presents the sensitivity, specificity, and likelihood ratios corresponding to each cut-off score. It is evident that the cut-off score associated with a likelihood ratio of 10.5015, which represents the largest difference between sensitivity and 1-specificity, is 78.5. The use of likelihood ratios plays a significant role in clinical studies. Literature review indicates that a likelihood ratio of 10 is considered a critical value for accurate measurement (Coetzee, 2004). Therefore, the current criterion value was employed in the current study. Based on this, the cut-off score for individuals in need of psychological support is 78.5 on the CLEIS. The sensitivity of the scale, with a likelihood of 0.527, indicates its ability to differentiate individuals exhibiting symptoms of stressful life events, while the specificity value of 0.050 suggests its ability to distinguish individuals actually experiencing stressful life events.

Table 6. ROC analysis for 78.5 cut-off score

		Need for psychological support		
CLEIS		I need it (Positive)	I do not need it (Negative)	Total
	CLEIS (Positive)	46	11	57
	CLEIS (Negative)	208	45	253
	Total	254	56	310

According to Table 6, the calculated positive predictive value (PPV = 46/57 = 0.80) demonstrates that the question regarding symptom presentation in stressful life events accurately identifies individuals with symptoms at an 80% rate. The negative predictive value (NPV = 208/253 = 0.82), on the other hand, indicates that the question correctly identifies individuals without symptoms at an 82% rate. The area under the curve represents the proportion of accurate predictions made by the determined cut-off point.

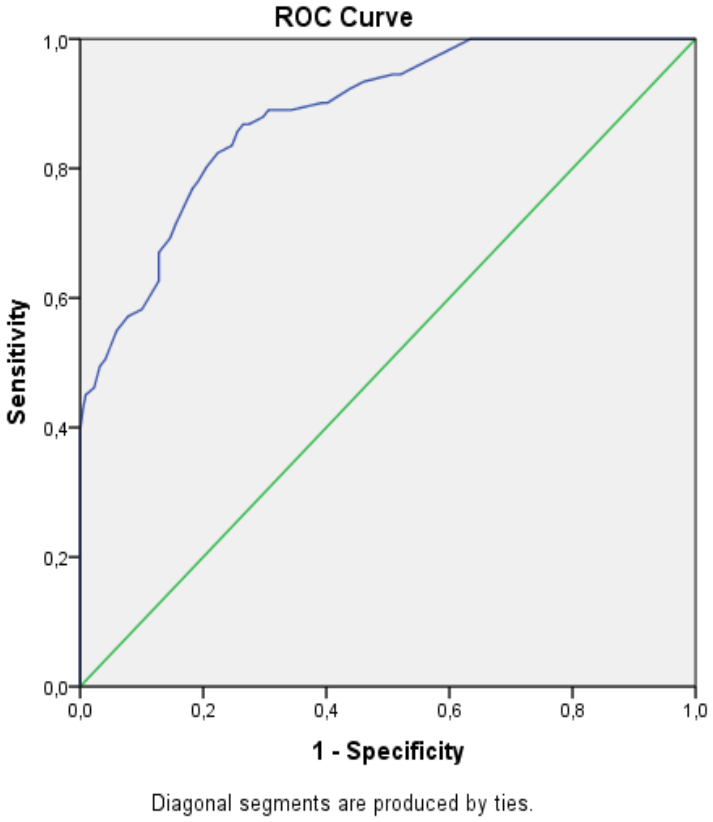


Figure 2.

Table 7. Area under the ROC Curve (AUC) for CLEIS

				95% CI
AUC	S.E.	*p*	Lower Bound	Upper Bound
.884	0.005	0.000	0.696	0.716

The area under the ROC curve (AUC) for CLEIS was found to be 0.884. AUC values between 0.80 and 0.90 are interpreted as "good discriminative ability" (Hanley and McNeil, 1983; Zou, O'Malley, and Mauri, 2007). The cut-off score is in agreement with the actual values at a rate of 88.4%.

DISCUSSION AND CONCLUSION

In the present study, the construct and content validity were considered for the validity practice of the scale, while Cronbach's alpha coefficient was taken into account for the reliability. For content validity, items related to the construct were developed, and three different experts in the field, including two associate professors

and one doctoral faculty member, were asked to give feedback. Confirmatory Factor Analysis (CFA) was conducted for construct validity with a sample size of 748, and it was revealed that the scale consisted of a three-factor structure, with the total variance explained by these factors reaching an acceptable level of 62.95%, as commonly accepted in social sciences (Tavşancıl, 2010). Item factor loadings (ranging from .60 to .82) and corrected item-total correlations (ranging from .43 to .73) for the scale were observed to be above the levels reported in the literature (Şencan, 2005). Moreover, the findings confirm the three-factor structure through confirmatory factor analysis (CFA) (n= 245) ($\chi 2/df=2.24$, CFI= .92, IFI= .92, RMSEA= .07, RMR= .06, SRMR= .04). The results obtained from CFA meet the goodness-of-fit criteria mentioned in the literature (Baumgartner and Homburg, 1996; Bentler, 1980; Bentler & Bonett, 1980; Browne & Cudeck, 1993; Hu & Bentler, 1999; Kline, 2011; Marsh, Hau, Artelt, Baumert, & Peschar, 2006). Upon examining the literature regarding the three factors of the scale, it is evident that there are difficulties in the individual's ability to establish connections and in the behavioral systems that generate a sense of control and meaning in the presence of traumatic events (Herman, 2019). In another study, it was found that soldiers who had participated in the American Civil War exhibited negative mental and physical responses, such as dizziness, chest pain, and palpitations (Ramsay, 1990). Similarly, Rienks (2020) states that behavioral, emotional, and physiological symptoms can emerge by trauma. The same researcher reported emotional symptoms as irritability and emotional numbness, while behavioral symptoms include hypersensitivity and loss of concentration. Figley (1995) also stated that individuals who have directly or indirectly experienced a traumatic event often face situations involving frequent exposure to emotions and thoughts related to the event, unwillingness to engage in any activities, withdrawal from people, inability to plan for the future, irritability, sudden outbursts of anger, difficulty falling asleep, and physiological responses to triggering events. In another study, it is indicated that individuals who have experienced a traumatic life event, either directly or indirectly, may exhibit reactions such as perceiving the world as unfair, experiencing eating problems, increased heart rate and breathing, experiencing hypertension and sweating (Kaya, 2015).

Some other research reported that individuals may exhibit cognitive, emotional, behavioral, and physiological reactions following a traumatic event based on their personal characteristics. These reactions include fear, hyperarousal, vigilance, increased blood pressure, sweating, trembling, feelings of loneliness, self-perception of worthlessness, and a sense of insecurity towards the world (Breslau, Davis, Andreski, Peterson, & Schultz, 1997; Cervatoğlu-Geyran, 1995; Southwick, Morgan, Darnell, Bremner, Nicolaou, Nagy, & Charney, 1995; Sungur, 1999).

The results indicated that CLEIS total scores were significantly correlated with perceived stress at a level of .72 and with perceived coping at a level of .46. Aksöz-Efe (2018) reported a significant positive relationship between challenging life events and the level of stress. According to DSM-5, it is stated that challenging life events can lead to negative changes in cognition and mood, resulting in secondary level symptoms of stress (Oginska-Bulik, Gurowiec, Michalska, & Kędra, 2021).

The Cronbach's alpha for the reliability was calculated as .96 (n=245). The obtained reliability value is consistent with the data in the literature (Kline, 2000). Additionally, the ROC analysis method was used to calculate the cut-off score. According to the analysis, the area under the curve for the total score of CLEIS was found to be 88.4%. Based on this, it can be inferred that CLEIS accurately identifies individuals in need of psychological support with an 88.4% likelihood. It is also noted in the literature that this range is considered to have a good discriminative ability (Hanley & McNeal, 1983; Zou, O'Malley, & Mauri, 2007). Furthermore, the presence of the likelihood ratio in measurement instruments is considered significant in clinical research. In this regard, when examining the literature, a likelihood ratio of 10 is considered a critical value for ensuring accurate measurement in health-related assessments (Coetzee, 2004). The cut-off score for CLEIS in identifying individuals in need of psychological support is 78.5. The sensitivity of CLEIS is 0.527, indicating that it can distinguish individuals who exhibit symptoms of stressful life events with a likelihood of 0.527. The specificity value is 0.050, indicating that it can distinguish individuals who truly exhibit symptoms of stressful life events with a likelihood of 0.050.

The CLEIS consists of 25 items and is composed of three factors: *Emotional Reactance, Cognitive Reactance,* and *Physiological Reactance*. The items are scored on a range from '1 = Strongly Disagree' to '5 = Strongly Agree'. There are no reverse-coded items. A total score can be obtained from each factor and from all factors combined. An increase in scores across all factors is interpreted as an increase in the corresponding response. In this context, the scale addresses the direction of symptoms exhibited by adults in response to stressful life events through a three-factor structure.

In summary, based on the conducted analyses, the developed scale can be considered valid and reliable. Additionally, a cut-off point was determined to enhance the utility of the measurement tool in determining individuals' need for psychological support. However, it is important to acknowledge certain limitations regarding the research sample and methodology. Therefore, it is recommended to conduct further scientific studies taking into account different age groups, various demographic variables, and potential symptoms that may be exhibited. Moreover, in order to establish the generalizability of the measurement tool, it is advised to particularly focus on individuals who have experienced stressful life events.

Statements of Publication Ethics

We declare that this study has no ethical conflicts or problems that may limit the article's publication.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Author 1's name	☒	☒	☒	☒	☐	☒
Author2's name	☒	☒	☐	☒	☒	☒
Author 3's name	☒	☐	☒	☒	☒	☒
Author 4's name	☐	☒	☒	☐	☒	☒

Conflict of Interest

We declare that there is no conflict of interest in this study.

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A Model Suggestion for In-service Teacher Training to Develop Mathematical Literacy

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Abstract

This study discusses an in-service teacher training seminar planned to train teachers for a teaching process in which mathematical literacy is integrated into teaching. The seminar's content was created according to the Dual Focus Teaching Model. This study, which is design-based research, was planned and implemented for a total of 28 hours in 14 weeks, including what mathematical literacy is, making the content of the teaching suitable for mathematical literacy, choosing and writing a mathematical literacy question, introducing the Dual-Focus Teaching Model, and module development, planning and implementation for the teaching process in which the model will be used. The data of the study were collected through semi-structured interviews. The findings are presented under the headings of mathematical literacy and views on the planning and implementation of integrated courses. The results showed that the seminar's content and methodology followed in the seminar were suitable for teaching mathematical literacy and revealed that interactive studies and instant feedback in the courses held within the seminar's scope were important for the training of teachers.

Keywords: Mathematical literacy, middle school mathematics teachers, professional development, Dual-Focus Teaching Model, teaching planning.

Matematik Okuryazarlığını Geliştirmeye Yönelik Hizmet İçi Öğretmen Eğitimi İçin Bir Model Önerisi

Öz

Bu çalışmada, matematik okuryazarlığının öğretimle bütünleştirildiği bir öğretim süreci için öğretmenleri yetiştirmek üzere planlanan bir hizmet içi öğretmen yetiştirme eğitimi ele alınmaktadır. Eğitim içeriği Çift Odaklı Öğretim Modeline göre oluşturulmuştur. Tasarım tabanlı bir araştırma olan bu çalışma, matematik okuryazarlığının ne olduğu, öğretim içeriğinin matematik okuryazarlığına uygun hale getirilmesi, matematik okuryazarlığı sorusunun seçilmesi ve yazılması, Çift Odaklı Öğretim Modelinin tanıtılması ve modelin kullanılacağı öğretim süreci için modül geliştirme, planlama ve uygulamayı içeren 14 haftada toplam 28 saat olarak planlanmış ve uygulanmıştır. Araştırmanın verileri yarı yapılandırılmış görüşmeler yoluyla toplanmıştır. Bulgular, matematik okuryazarlığı ve bütünleştirilmiş derslerin planlanması ve uygulanmasına ilişkin görüşler başlıkları altında sunulmuştur. Sonuçlar, seminer içeriğinin ve seminerde izlenen metodolojinin matematik okuryazarlığı öğretimi için uygun olduğunu ve seminer kapsamında gerçekleştirilen derslerde etkileşimli çalışmaların ve anında geri bildirimin öğretmenlerin eğitimi için önemli olduğunu ortaya koymuştur.

Anahtar Sözcükler: Matematik okuryazarlığı, ortaokul matematik öğretmenleri, mesleki gelişim, Çift Odaklı Öğretim Modeli, öğretim planlama.

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INTRODUCTION

In recent years, the concept of "mathematical literacy (ML)" has come to the fore in secondary school mathematics teaching (Niss et al., 2016; 2017). The importance of ML in the agenda of secondary school mathematics teaching can be attributed to two main reasons. The *first* of these is *the incompatibility observed between school mathematics and life*. While explaining this situation, Steen et al. (2007) stated that "ML focuses on the use of basic mathematical knowledge and skills, while school mathematics focuses on the basic skills of advanced mathematics". The said disintegration and the problem it caused became more known all over the world when the Organization for Economic Co-Operation and Development (OECD) organized the Program for International Student Assessment (PISA), the primary purpose of which was to measure the level of ML achievement (OECD, 2019). For example, despite the time and effort spent on mathematics across the country, according to the latest PISA report, 61% of students in Turkey can only minimally recognize the mathematical representation of a simple situation (such as comparing the length of two different roads) (Ministry of National Education – MoNE, 2023). This shows that more than half of our students have low levels of mathematical proficiency (OECD, 2023). The *second reason is the reflections of access to information, which has become facilitated with technological developments, on teaching*. With the unrestricted use of the internet in 1985, it became easier to access information, and it became sufficient to spend less energy and time acquiring knowledge at school. When both situations are evaluated together, as and when the opportunities created by the facilitation of access to information are used to gain competencies that will be functional in the use of information in life, it can be thought that it is possible to reflect school mathematics more on human life. This situation, that is, the reflection of the learned knowledge to life, is expressed by the concept of ML, which has become well known with PISA assessments, and has become the main target of education mathematics programs today (see, MoNE, Secondary Education Mathematics Teaching Program, 2009, p:5).

The most influential factors on the emphasis on increasing ML achievement are teacher, student, and learning environment (Boesen et al., 2014; Niss et al., 2016; 2017). Niss et al. (2016; 2017) stated that teachers' knowledge of competencies strongly determines students' competencies. Teachers play an important role in scaffolding students' mathematical experiences so that they are more able to integrate mathematics into their real lives (Sumirattana et al., 2017). Botha et al. (2013) sought the answer to the question, “Is there a way, a method to teach ML effectively?”. They investigated teachers' teaching practices and how much they brought them into the classroom. In addition to being knowledgeable about practices, they determined that teaching experience plays an essential role in the productivity of teaching practices. Martin (2007) also stated that ML does not stem from the content of teaching but from the teaching methods performed by teachers. Traditional teaching methods, which involve memorising mathematical rules or formulae that are not relevant to students' real life or experiences, have failed to develop students' ML (Sumirattana et al., 2017).

These results suggest that a profound revision of the teacher education program or a special mathematics teacher education program is needed to develop ML. The primary purpose of our study, which focuses on this idea, is to reveal how "teacher education" should be, which can provide qualified ML teaching. To achieve this aim, the in-service teacher training part of the project named "Developing Mathematics Literacy with Dual-Focus Teaching Model", which was carried out and completed to improve ML teaching in the process, is discussed in terms of content and method, and its adequacy is discussed.

THEORETICAL FRAMEWORK AND LITERATURE REVİEW

Since it is closely related to the subject, information about ML, mathematical competencies, and Dual-Focus Teaching Model is given in the following section.

Mathematical Literacy and Its Integration into Teaching

The definition of ML in OECD resources is: “It is the capacity of individuals to formulate, use and interpret mathematics for various scopes and contents. It includes mathematical reasoning and the ability to use mathematical concepts, processing steps, verified information, and tools to describe, explain, and predict events. It helps individuals realize mathematics’ role in the world and make well-founded judgments and decisions that constructive, sensitive, and reflective citizens need." (OECD, 2013; 2023).

ML was seen as a solution to eliminating the gap between school mathematics and life, and the issue of how to teach has gained importance. Some studies on its teaching are as follows: Bansilal et al. (2015) analyzed teacher thoughts to identify the critical elements of a teacher training program for ML teaching. They concluded

that teacher education programs should be aligned with the subject's objectives, and competencies should be met within the curriculum. In a similar study, Frith and Prince (2006) introduced a program called "Advanced Certificate in Education" to increase the quality of ML. This program was conducted on 33 teachers, and it was reported how teachers perceived themselves as practitioners of ML. It was ensured that students had a share in determining the course content, critical thinking and communication were given importance in teaching, and collaborative studies were encouraged. This study concluded that the ML course carried out with these principles provides an effective environment for ML. Lengnink (2005) stated that it could be possible by developing a unique action style in his processes and called for a mathematics education that teaches this.

Mathematical Competencies

Mathematical competencies are concrete skills required to carry out certain mathematical activities (Jankvist & Kjeldsen, 2011). Different mathematical competencies constitute mathematical competency (Niss & Højgaard, 2019).

Competencies in mathematics teaching by different academic circles are defined under proficiency frameworks (mainly PISA, KOM, NCTM, MCRF, and NEPS proficiency frameworks). Although partial differences exist, almost all frameworks include problem-solving, reasoning, representation, communication, and modeling competencies.

To what extent an individual is mathematically literate can be decided by looking at the degree to which he reflects the mathematics he has learned to life situations. The reflection here is (i) Using mathematics to clarify a situation, (ii) Being able to model, (iii) Using mathematics as much as possible in the organization of social life, (iv) Handling events with a mathematical understanding, and (v) Appreciating the value of mathematics as a result of all these reflections. (Lengnink, 2005) All these forms of reflection can be revealed through mathematical competencies. In this respect, ML teaching requires the development of mathematical competencies. There are many studies on developing competencies in the teaching process or how to shape teaching to develop competencies (e.g., Blomhøj & Jensen, 2007; Niss et al., 2016).

Under the "Recommendations for Teachers for the Development of Competencies" title, OECD (2016) explained what teachers can do in their classrooms to develop student competencies and how to do them. Some of the suggestions made here are summarized as follows: i) Although not every student is expected to be a mathematician, the teaching of competencies is a necessity as they are necessary for all kinds of vital activities. (ii) Project assignments that are started in the classroom and completed outside should be included, and such tasks should not be abandoned by taking refuge in the well-known limitations of the curriculum. (iii) The questions should be varied, and the competencies should be allowed to be demonstrated. (iv) Cognitive activation of students should be kept active by summarizing, questioning, and guessing activities. (iv) Activities that allow students to work together or use new tools, such as technology and games, should be designed to reinforce mathematical concepts.

Palmer et al. (2018) conducted a study revealing the potential of mathematical competencies in teaching in primary schools. In this study, it was stated that for the development of entrepreneurship and mathematical competencies in the teaching process, changes in the role of the teacher are necessary, and there is a need for a "teacher who speaks less" and "a teacher who gives more room to leave the control to the students". In another study, Gresalfi et al. (2009) examined the development of competencies based on discourse analysis between teachers and students in mathematics courses in two secondary schools. This study revealed the importance of student's participation and learning opportunities in mathematics lessons for the development of ML. In the study of Blomhøj and Jensen (2007), it was stated that some mathematical competencies should be included in mathematics education for ML. Some other research; for example, Frith and Prince (2006), and Bansilal et al. (2015), emphasize that the development of ML should be met within the curriculum. Mbekwa (2006) and Bansilal et al. (2015) stated that there is a partial resistance to learning ML; Brown and Schafer (2006) stated that ML develops late, and it is possible to get good results over time.

Dual Focus Teaching Model

Today, the expectation of more reflection on knowledge in life has changed the form and content of teaching. Learning methods and techniques (5E, learning by discovery, teaching with the help of definitions, etc.) developed for learning theories focused on "knowledge creation" were insufficient to gain skills related to reflecting knowledge in life. This is because in traditional teaching, competencies remain insignificant next to learning, and they are contented as much as they can while acquiring subject knowledge. To meet this need in teaching, that is, to develop competencies within the teaching process, a Dual Focused Teaching Model (Cift

Odaklı Öğretim Modeli - COM) has been proposed (Altun, et al., 2022a.; Altun, et al., 2022b). These developments can be schematized as in Figure 1 regarding the fact that the concept of ML became more known and included in the curriculum with the PISA assessments that started in 2000:

Looking at the historical course of the developments in teaching (Figure 1), behavioral approaches left their place to cognitive approaches in the 20th century, and constructivist teaching has been more widely accepted among them (Fosnet, 2007). Constructivism is a theory of knowledge and deals with how knowledge is formed. The reflections of constructivism on teaching have been in the direction of increasing the quality of gaining knowledge (Jaworski, 1998). Another cognitive approach that affects mathematics teaching is "Realistic Mathematics Education (RME)". While RME also has a constructivist philosophy at its core, the difference from the constructivist theory emerges in reaching knowledge (Gravemaijer, 1999). As a result, the main goal of both theories is to gain understanding and increase quality in this process. In Figure 1, it is seen that the development of competencies in teaching has gained importance at the knowledge level and has taken its place in the teaching content as of the 2000s.

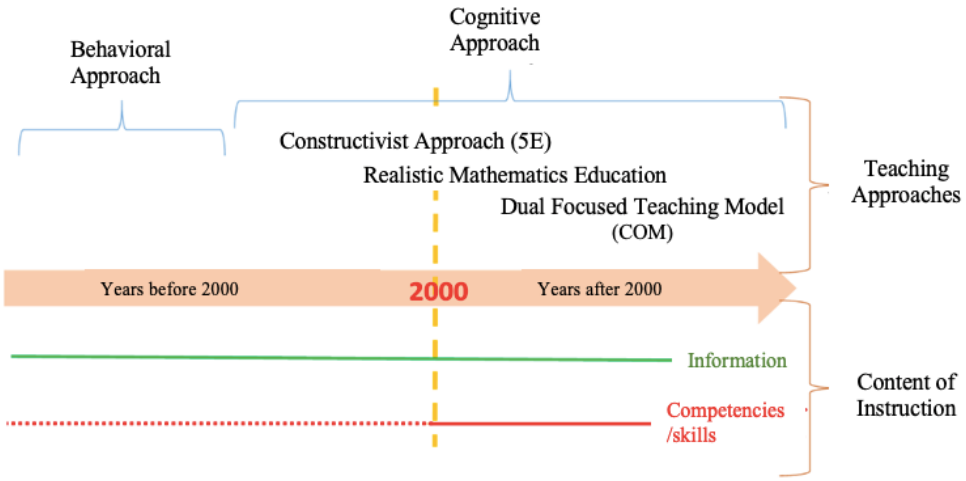

Figure 1. Historical process of involving knowledge and competencies in teaching

COM, which enables the programmatic development of competencies as well as gaining knowledge, teaches a mathematics subject. This approach deals with teaching at two focal points and their complementary work. The first focus is "work to gain knowledge". The constructivist approach gains knowledge, and as a complementary work, the deepening of the meaning is included. The second focus is "Teaching studies to ensure the reflection of knowledge in life": ML questions, vital applications of knowledge, etc. It is a simple approach and does not burden the teacher extra. As the lesson planner, the teacher needs to organize appropriate activity(s) to reach knowledge in the first focus and find ML questions and vital application example(s) of knowledge for the second focus. The two basic principles of COM are: "Mathematics is a matter of reflection and discussion" and "Teacher who speaks little". Both principles allow students to produce knowledge and defend their thoughts freely during the lesson. Exercises and verbal problems related to the subject remain in COM process (For detailed information, see Altun, et al., 2022b).

METHOD

The method of the research is "design-based research". Waug and Hanefun (2005) describe design-based research as "the investigation of cyclical analysis, design, development, and implementation processes. It is a systematic research method conducted in collaboration with the participants and in a real practice environment to develop context-sensitive design principles and theories and improve educational practices. In this study, a 28-hour seminar program for 14 weeks was prepared and applied to a selected group of teachers. The seminar content was constantly revised, considering the expectations of the participating teachers and the interim evaluations during the implementation. In this way, the study has a structure that overlaps design-based research. Specific forms of design-based research are tailored to how they are conducted in some specific areas. This study is suitable for "formative research," which aims to improve teaching systems from these. Information on the seminar's content, the participants' determination, the data collection tools, and the data analysis are given below.

Content of Teacher Training Seminar Integrated into ML

COM was used to determine the content of the teacher training seminar because it includes the literature and the development of competencies (Altun, 2021; Altun, et al., 2022a; Altun, et al., 2022b). The teacher training seminar consists of five main parts: (i) What is ML (2 hours), (ii) Choosing and writing an ML question (8 hours), (iii) Adapting the teaching content to ML (8 hours), (iv) Introducing the COM (4 hours) and (v) Module development, planning, and implementation (6 hours) suitable for COM.

The first chapter introduces how the term ML was conceptualized, its meaning and scope, its competencies, the historical development of PISA applications, and the reflections of the results on teaching. In the second part about writing ML questions, the differences between ML questions from traditional exam questions, contextuality, and references in writing ML questions are introduced. Then, examples of questions from numbers, geometry, data, change, and relations, the primary subjects of secondary school mathematics, were examined, and how the solutions were evaluated was discussed. In the third part, within the scope of making the teaching content suitable for ML teaching, the concept of activity, the use of activities to reveal concept knowledge and generalization information, and the teaching design ideal for the deepening step were studied. In the fourth chapter, the introduction of COM is given. Finally, it has been learned how to develop the competencies in writing, applying, and applying the module or lesson plan content according to COM possible opportunities, and difficulties to be encountered. For detailed information, examples, and activities regarding the seminar's content, the book Altun et al. (2022b) prepared can be reviewed.

In the planning of the seminar, the following principles were taken into account to *preserve the constructivist character of the teaching and to ensure the development of competencies*:

(i) Interactive studies should be adopted to implement the seminar program. It is important to keep individual discussions and discussions open during the teaching, check the daily homework given, and convey the corrections/feedback on the homework papers to the participants.

(ii) Instructional content should be a quality that will contribute to developing a sense of value toward mathematics.

(iii) Teachers should be encouraged to join or oppose the seminar's organizer by referring to the principle that "mathematics is a matter of thinking and discussion" during the seminar process (Altun, et al., 2022b).

Selection of Participants

To determine the teachers who will participate in teacher training, a call was made to the mathematics teachers working in secondary schools through the Bursa Provincial Directorate of National Education, and 49 teachers applied for this call. To determine those who will participate in the training, the applicants were asked to fill in an information form that included questions about their educational status, their experiences in ML, and the schools they worked at, and 32 teachers were determined by evaluating the answers given.

The demographic characteristics of the participants are as follows: According to gender, education level, and institution: 27 female, five male, 28 undergraduate, and four graduate. Twenty-eight of them teach in public schools, and 4 in private schools. Their professional experience ranges from 1 to 18 years.

Their accumulations on ML are; 3 teachers stated that they would encounter the concept of ML for the first time; most of the others indicated that they had encountered the concept before, but their knowledge was limited to the discourses about PISA and TIMSS assessments, and seven teachers said that they participated in an in-service course or seminar-like study on ML.

Data Collection Instrument and Process

At the end of the seminar, the research data were obtained through the interview form developed to determine the participants' thoughts about the seminar's effectiveness, the level of reaching the goals and satisfying their expectations, and the issues that need to be improved. This interview form was designed as semi-structured (Uslu & Demir, 2023) and consisted of open-ended questions. Models used in the evaluation of in-service training programs (Guskey, 2000; İnaltun, 2019; Yermeydan-Uğur, 2017; Yıldız, 2017) were used in the development of the interview form.

Firstly, a draft interview form was created. The draft form was then sent to three faculty members who are experts in the field of mathematics education. When the expert opinions were examined, it was seen that the feedbacks were generally for the intelligibility of the items forming the form, and there was no need for a comprehensive change in the content. After the expert's opinion, necessary adjustments were made to the draft form, and 15 interview items were included under five main headings in the state. Finally, the researchers applied

the form to the teachers who had received similar training before. As a result of these studies, some corrections were made to the items that were found to be partially overlapped. Through the interview form, which was given its final, online interviews were conducted in the week following the completion of the teacher training. Each interview, conducted by one of the authors of the present study, lasted 30-35 minutes. All online interviews were recorded with the permission of the teachers.

To check the reliability of interview instrument, participants were asked, “Do you recommend that other mathematics teachers take this training as well? If your answer is yes, explain why.” The question was asked, and the consistency between the answers given to this question and those offered for the standard evaluation questions was examined. The degree of consistency was evaluated as a measure of the reliability of the interviews.

Data Analysis

First, to analyze the qualitative data obtained from the interviews, transcripts of the recorded interviews were extracted. The data obtained from the interviews are based on the teachers' comments and statements about the training's content, applicability, and effectiveness. The data obtained from the interviews were subjected to content analysis. Based on the expressions here, categories and themes were determined, respectively.

Research Ethics

Ethical principles and rules were followed during the planning, data collection, analysis, and reporting of the research. The study was carried out after obtaining the permission of the ethics committee of ... University.

FINDINGS

Findings of the study; (i) Opinions about ML, (ii) Opinions about the contribution of the seminar to preparing the lesson plan, (iii) Opinions about the effectiveness of the teaching and the COM, (iv) Suggestions for the structuring of the education given (v) Reasons for (not) recommending this training to colleagues presented under the headings.

Opinions about ML

At the end of the seminar, questions were asked to the teachers about what ML is and how it can be improved. The findings obtained from the interview data formed three themes: conceptual information about ML, ML questions, and handling ML in the teaching process, which is presented in Table 1.

Table 1. Teachers' Opinions on ML at the end of the Seminar

Theme	Category	Code	f
Conceptual information about ML	Specializing in ML	Gaining awareness of ML	20
		Ability to integrate mathematics into daily life	17
		Domination over ML	13
		Clarification of confusion	4
	Skills included in ML	Deciding	2
		Reasoning	2
		Reading comprehension	1
	ML's contribution to attitudes	Love mathematics more	5
		Students gain confidence in solving ML questions	2
		Changing students' perspective on mathematics	2
	The role of the teacher in the development of ML	The importance of teacher's knowledge for ML	3
		Math literate teacher	3
ML problems	Information on ML problems	Detecting the ML problems	8
		Noticing topics that can/can't be ML problems	3
ML in the Teaching Process	Changes in teacher	Seeing mistakes and shortcomings	7
		Change in teaching style	3
		The tasks that are not difficult for the teacher in the process	2
		Being open to innovation	1

Changes in teaching practices	Make time for events	5
	Creating an environment for discussion	4
	Less room for exercises	4
	Early initiation of ML studies	3
	Working on improving the ML	2

Teachers stated that they specialized in ML with this training (Table 1), gained awareness of ML (20), and were no longer intimidated by ML questions. They dominated ML (13), could integrate mathematics into daily life (17), and were able to think about ML. (4) stated that their confusion became clear. Some have mentioned that the concept of ML includes skills such as decision-making (2), reasoning (2), and reading comprehension (1).

They stated that after this training, they could make students love mathematics more with ML (5), they could gain confidence in solving ML questions (2), and they gained the potential to change the students' perspective on mathematics (2). Finally, they stated that the teacher's knowledge is important in the development of ML (3) and they realized that the teacher should be mathematically literate (3).

The second theme (Table 1) regarding the change in perspectives is related to ML questions, and they stated that not every question is an ML question, and they can now easily identify ML questions (8). Regarding this situation, two teachers have shared their views;

T2: *"I had a different thought when I set out on the road. I thought questions with lots of words and paragraphs were ML questions. The main thing is to be realistic from daily life, interpret it, and make you think."*

T7: "I thought I was doing an ML question by adding a picture. But I realized I was on the wrong track.".

They stated that they understood that ML questions changed their perspectives on mathematics, that not all of the questions used in a course had to be ML questions, and that some subjects (percentage, interest, etc.) were more suitable for ML (3).

The third theme (Table 1) concerns how they perceive ML in the teaching process. Teachers stated that they had the chance to see the mistakes and shortcomings they made during the teaching process (7), they changed their teaching style (3), they realized that they had tasks that were not difficult (2) and that they needed to be open to new things (1). Regarding the change in teaching practices, they stated that while they did not dare to do activities for fear of losing control, they understood that it was necessary to devote time to activities (5). They realized it would be sufficient to create a discussion environment (4) and give less space to exercise; spacey stated that teacher education should start working in the early period (5th grade) to develop ML (3), and after that, they should worry about developing ML and work on it (2).

Opinions on the Contribution of the Seminar to Preparing the Lesson Plan

The teachers participating in this study were asked to what extent they felt ready to prepare a lesson plan suitable for ML, and the findings are presented in Table 2.

Table 2. Contribution of the Seminar to Prepare Lesson Plans for ML Integrated Courses

Theme	Category	Sub-Category	Code	f
Prepare a lesson plan in which ML is integrated	Yes	Absolutely		17
		But…	Practice more	4
			Difficulty preparing events	1
			Difficulty finding an original activity	1
			Unsure of accuracy/Need for confirmation	1
	Not sure	Because…	Don't require much effort	2
			Quantitative adequacy of samples	2
			The difficulty of the first focus	2
			Anxiety about not gaining concept knowledge	1
	No	Because…	Absenteeism in education	3

As seen in Table 2, most teachers (17) stated that they could *prepare*. Some of them said that they *could prepare*. Still, they needed more practice in preparing a plan (4), and they needed help in designing an activity (1) and finding a unique activity (1). They were still determining the accuracy of all plan stages and needed approval (1). Some of the teachers stated that the examples they encountered in the seminar were not quantitatively sufficient (2), that it required much work (2), and that it was challenging to find activities suitable for gaining concept knowledge (2). Three teachers said they could not prepare a lesson plan because they could not fully participate in the training. In addition, they stated that they had the opportunity to see how to attract students' attention through teaching with activities, which is an important dimension of COM (2). Regarding teaching with activity, T2 stated that *it is very important because it will attract the attention of students who have never been interested in mathematics, make them love mathematics, and develop a positive perspective*. Teachers also stated that they realized that there are points where they need to be more sensitive in planning lessons. For example, a teacher expressed, *"Now I choose the questions that I carry into my lesson plans with more subtle thoughts. I want to make sure they are questions based on the construction of knowledge."*.

Opinions on the Effectiveness of Teaching and The Dual-Focus Teaching Model

The teachers participating in this study were asked for their opinions about the effectiveness of the education they received, the usefulness of the COM, and the negative situations that may arise in using the model. The findings are presented in Table 3. The teachers' opinions were gathered under the themes of the operability of the teaching process and the sustainability of the teaching (Table 3).

Table 3. Contribution of the Seminar to Prepare Lesson Plans for ML Integrated Courses

Theme	Category	Sub-category	Code	f
Teaching Process Operability	Functional states	Teaching Qualification	Relating mathematics to life	10
			Providing permanent learning	9
			Fun learning environment	8
		Planning	Lesson planning and method	4
		Content of the Instruction	Teaching with activities	4
			Giving room for discussion	4
			Supporting the subject with applications Developing the ML	4
		Sense of Value	Changing perspective on mathematics	7
			Developing a sense of valuing mathematics	4
		ML problems	Developing question writing	3
			Looking critically at questions	2
Sustainability of Teaching	Blocking situations	Systemic	Having time problems in raising the subjects	10
			The effect of multiple-choice questions in the central examination system	4
			An excess number of students in classes	2
		Subject-based	Difficulty in finding ML questions suitable for the topic	4
			Inability to devote enough time to the second focus	3

As can be seen from the high-frequency values in Table 3, most teachers stated that the COM is a well-functioning teaching model in the mathematics teaching process. They explained the reason for this with expressions such as enabling the student to associate knowledge with life (10), realizing permanent learning (9), and making the learning process enjoyable (9).

While in-service teacher training was continuing, one of the teachers applied his lesson plan, which he had prepared by the COM, in his class and described this process as *"In my classes in 6th and 8th grades, I taught my lesson by applying the plans I had prepared. I started with the question and activity that would interest them in the first focus. At the end of the activity, I enabled the students to conclude. They liked that the students could find*

the formulas they used by the heart. The activities carried out increased the participation of the students. In the second focus, I included reinforcement work. I got good feedback. Thus, I saw the effect and usefulness of the model.".

The teachers (4) stated that the way of teaching the lesson makes the thoughts of students at all levels feel essential and gives the students a personality, makes them realize the necessity of mathematics in real life and its role in life, and encourages them to participate in the lesson. They emphasize the issues of which applications and how to support them to r to provide in-depth learning about mathematical concepts are quite effective for them. T2 expressed his opinion regarding this situation: *"I contributed to conveying to the students where we encounter mathematics in daily life."* Another group of teachers (3) got to know ML for the first time with this training. T4: "*I liked that we will get out of the routine and encourage students to be more literate."* He described the most compelling aspect of education for himself. Another teacher T12 Expressed his opinion: *"I think that if the teacher cares about literacy, the teacher will automatically care about the child. It was the most effective part because it changed my perspective from that point of view."*

In another dimension, teachers reported that there was a change in their perspectives on mathematics (7) and that they realized the importance of valuing mathematics with this education (4). Regarding the sense of value, T8 said, *"Attitude development was not my priority in my classes. But during this training, I saw that this should be the priority."* He stated that their education changed some of their views about students and that only some students could be successful in every subject thanks to this training. In parallel with what they have stated here, during their teacher education, they realized where and how the logic and basis of the things taught by rote for years came from, thanks to this training. They gained experience in how they can transfer the taught mathematics to the students' lives and how the abstraction of the taught information will take place in the minds of the students.

Teachers stated that they learned how to write ML questions thanks to this training (3) and even experienced this process for the first time. They indicated that they realized that the features of ML questions should not include unnecessary information in the context of the questions, be short, contain explanatory statements, be related to daily life, and that mathematical knowledge should be addressed. T3 explained what is meant by not ignoring mathematical knowledge: *"I realized that I ignored mathematics in the things I wrote to be a new generation question, ... I saw where I made a mistake. I saw what I needed to pay attention to".* Regarding the difficulty level of the ML question, the teachers stated that with this training, they realized that not every ML question had to be complicated. At the same time, they expressed that they needed to raise awareness in students that such questions are not complex.

Teachers, who stated that they focused on solving many questions and teaching knowledge rather than ML before the training, even in the same style, said that they realized that they should focus more on ML in their learning processes. One of the teachers expressed his opinion as;

T1: *"I experienced not solving too many questions, but a good activity enables effective learning."*

T6: *Two teachers contributed to my critical approach to all questions regarding their suitability for ML*. Finally, one teacher found it effective to be equipped to write ML questions and said, *"I am not afraid of ML questions anymore. Because I'm writing a question. I am prepared."*.

The teachers were asked for their opinions about the situations that could hinder the implementation of the COM, and their answers were collected in two categories. The first category is the barriers originating from the education system, and due to the intensity of the exams and curriculum in the academic calendar of the schools, time problems in the training of the subjects, multiple choice questions in the central examination system, and the high number of students in the classes are possible obstacles. The second category, on the other hand, is the situation specific to the structure of COM and the difficulty in finding the appropriate ML question for the second focus because it takes too much time to explore in the first focus. The difficulty in finding the appropriate ML question is expressed as situations that may hinder the application of the model (Table 3).

Suggestions for Structuring the Training Provided

Teachers were asked questions to get their suggestions for the studies to be done in case the education will be re-run or the current education will continue, and the findings are presented in Table 4.

Table 4. Teacher Recommendations for the Structuring of the Education

Theme	Category	Code	f
Studies to increase the quality of education	Lesson plan design	Increasing lesson plan discussions	8
		Increasing the lesson plan preparation part with ÇOM	1
		Include lesson plan examples rather than the theory part	1
	Lesson plan applications	Evaluating classroom practices	3
		Changing and implementing lesson plans	2
		Sharing negative aspects of implementations	1
	Write/solve ML problems	Increasing question-writing efforts	5
		Creating a question pool	2
		Sharing more detailed feedback on question writing	1
		See progress in question writing	1
		Not including the solution to known ML questions	1
	Activities	Creating an activity pool	2
		Continuing the activities and writing ML questions together	1
		Carrying the applications of the activities in the classrooms to education	1
		Sharing more activities	1
		Preparing activity papers	1
Studies carried out before, during, and after the training	Implementation of training	Face-to-face (interactive) training	9
		Enrichment of the online environment	3
		Including the use of technology	1
		Preparing a clipboard	1
	Assignment	Giving regular (periodic) assignments	2
		Increasing homework frequency	1
		Giving group assignments	1
		Increasing in-class interaction instead of homework	1
	Studies for post-training use	Material design	2
		Preparing a guidebook	1
		Sharing all work in education	1
		Sharing questions produced through mobile applications with students	1
No Suggestions			1

For the studies that will increase the quality of teaching, it has been requested that more discussions be made about lesson plans (8), that lesson plan preparation studies should be given more place (1), and that application examples rather than theoretical knowledge regarding lesson plan preparation (1) should be included (Table 4). Regarding this, T4 said: *"A little narrowing of the ML part and more space can be given on the plan. There can be more room for writing a lesson plan and asking teachers for it."*. It was asked to follow and evaluate the classroom practices for the implementation of the lesson plans studied (3), to revise and apply the existing plans (2), and to carry them into the process in case of negative situations experienced during these practices (1). In addition, another application that is requested to be increased is about writing ML questions and increasing the number of question writing activities (5), creating a pool of questions for the questions written and to be written (2), getting more detailed feedback from the academicians who provide training on the questions written (1), and sharing the first and last versions of the questions in the writing study (1) were mentioned. While the teachers demanded an increase in activities such as writing activities and preparing lesson plans, they expressed an increase in such studies by giving less space to some existing studies (such as reducing theoretical knowledge) rather than extending the education period. For example, T6 said: "*We saw ML questions a lot through examples, I agree, but especially the theoretical parts were challenging. This part may be reduced and perhaps better by writing one or two questions in consultation, as one makes an idea on writing a question during the lesson, and the other adds to it.".*

Finally, under this theme, teachers had some suggestions for activities. The need to create a pool (2) for the activities that have been written and will be written has been expressed. Teacher T8 expressed his expectation: "*I would like to have an activity pool. For example, it would be nice if we could make a topic. For example, seeing the coordinate system, equation graphics, and what kind of activities there are can give us an idea.".* The fact that the activities related to the activity were towards the end of the training was criticized, and it was suggested that the activities and ML question writing studies to be carried out together (1) and that more activities should be included in quantitative terms (1). About the importance of carrying the practices of the activities in the classroom to the teacher education environment (1), S12 explained: *"For example, I would like the teachers to carry out the activities that you do. It's one thing to see it by watching it; it's another to apply it ourselves. Because if we are going to make that child do it, we must try these kinds of activities ourselves first.".* During the implementation of this activity, they expressed their demands in the form of preparation of activity papers for convenience (1).

Another theme related to the suggestions is associated with the form of teaching. First of all, the situation that is especially emphasized here is related to the conduct of teacher training online due to pandemic conditions. Many teachers (9) preferred a face-to-face education with more intense interaction. T25, one of the teachers, explained this situation: "*our most important shortcoming was that we could not do face-to-face education and that limited education"*. In parallel with this, some teachers (3) wanted the online teaching environment to be enriched, and teacher T10 said: *"For the more active participation of teachers, pdfs can be projected via zoom as a presentation method and an online environment where anyone can write notes and discuss it."*. Similarly, it was stated that studies such as giving more space to the use of technology for the online environment (1) and preparing a board (1) to keep essential/critical information in the foreground in the process could be done.

An important application in the education process is the homework given to the teachers. The teachers generally welcomed the assignments, and T7 gave this situation: *"Assignments were very appropriate. Yes, I was tired while doing my homework, but I put much effort into it. Homework should be increased."* a further increase. In parallel with this, regular (periodic) assignments (2) and group assignments of 3-4 teachers (1) were requested. One teacher stated that in-class interaction should be increased instead of homework.

Teachers also suggested some resources and worked for use after completing the training. It is recommended to design materials that will support the teaching of the subject (2) and to share all the studies in education for later use (1). Preparing a guidebook to provide teachers with ease of application; *"Previously, there was a special guidebook for teachers. They are preparing a good guidebook that my colleagues and I can use. Here, unit by unit, topic by topic. It's like a daily plan. There will be next generation question activity exercise in it. Frankly, I think that doing something like this will be much more efficient and effective in the future."* (T20) with a statement. Finally, it has been suggested (1) to use mobile applications to provide easy access to the questions produced by the students. Regarding this, T11 expressed his opinion: "We give students questions, *but there is nothing that the student can access from a different platform. For example, many mobile applications can now be embedded within the mobile application."*

Reasons for (not) Recommending This Training to Colleagues

The teachers were asked whether they would recommend other teachers on duty to take this training, and if so, the reasons they would put forward for this, and the findings are presented in Table 5.

Table 5. Reasons for Recommending Participants Take This Teacher Training to Other Teachers

Theme	Category	Code	f
Yes, …	Contribution to teachers	Providing professional development in ML	8
		Gaining awareness of ML	4
		Obtaining valuable information	4
	Contribution to enriching the learning-teaching process	Relating mathematics to life	7
		Prepare an ML question	5
		Teaching with activities	4
	Contribution to students through trained teachers	Expanding perspective on math	4
		Contribution to breaking the fear of mathematics in students	2
		Enabling original thinking	2

		Understanding that math is valuable	2
Indecisive	Useful though!	Volunteering should be essential	2

All but two teachers who received training stated that they recommended other teachers to take this training (Table 5). The first reason for their suggestions is related to the individual contribution that teachers will provide to them. These contributions were discussed in three different dimensions, and the teachers stated that they would provide professional development through this training (8) to gain awareness about ML (4) and to acquire valuable information (4).

Another dimension in suggesting that they should take the training is related to the contribution towards enriching the learning-teaching processes. They reported that they would have the opportunity to see how mathematics can be associated with life (7), to prepare ML questions (5), and to teach with activities (4).

T20 said, *"I recommend it. I think there will be an 80% increase in students learning about the activity because it increases retention. I think it will increase its permanence with an event like this instead of memorizing the formula like a theater stage."*. T22, who had the opportunity to personally experience the contribution of teaching to the lesson with COM, said, *"I can recommend it in terms of lecture. I recommend explaining with a dual-focus education model how it contributes to mathematics."*.

The last category is about the contribution to be made to the students through the teachers who are trained. First of all, it was stated that the teacher education received provides the students with the opportunity to expand their perspective on mathematics as the first reflection (4), and one of the teachers T11: *"I definitely recommend it. I have found it very useful and I will apply it. I believe that the student once changed his point of view on mathematics, that is, my students also changed it…"* he shared his opinion on this situation. In addition, the teachers suggested that this training should be taken as it provides opportunity and contribution in terms of thinking originally (2), breaking the fear of mathematics (2), and understanding that mathematics is valuable (2).

Two teachers, who were hesitant to suggest other teachers receive this training, were still determining the benefit it would provide but stated that such training should be taken voluntarily. One of these teachers explained the reason for indecision" T17 said, *"I would like to, but is this actually possible! In fact, the old system is our comfort zone; these new systems are causing us to leave our comfort zone. Otherwise, it would be beneficial for them to receive this training."*

DISCUSSION

This study discusses the way of training teachers who will enable students to become mathematically literate through a program in which ML is integrated into teaching. In this section, the extent to which the seminar's aim was achieved was evaluated according to the order in which the findings were presented. Then the planning and implementation stages of the instruction were discussed. It should be noted that although this study references the COM, it first discusses a "teacher education model". In this respect, it can be considered a teacher education model independent of the COM.

As to Whether the Purpose of The Seminar Was Achieved or Not

Whether the seminar's goal has been achieved can be understood from the participants' thoughts about ML, their opinions about the seminar, and the reasons for recommending the seminar to other teachers. Although the participants had very limited knowledge about ML before the seminar, the high frequency (20, 17, 13) themes of having knowledge about ML, associating mathematics with life, and mastering ML at the end of the seminar (Table 1) suggest that the seminar achieved its purpose.

Other indicators supporting the achievement of the seminar's purpose (Table 1) are participants' emphasis on reasoning and decision-making as skills developed; It can be shown that they adopt the appropriate environment for developing competencies by including activities and discussion as the characteristics of the learning environment. These results indicate that Blomhøj and Jensen (2007) stated that "competencies should be included in teaching for ML; Niss et al. (2016) cared about teachers' knowledge about ML for the development of ML (Table 1); Niss et al. (2016)'s conclusion that the most potent factor in ML teaching is the teacher factor.

Regarding Lesson Planning and Implementation

The majority of the teachers (17) found it easy to plan a lesson by the COM (Table 2), and some of the teachers stated that they had difficulty in finding activities suitable for the content of the first-focus teaching and were unsure whether the activities they found served the purpose (Table 2). suggest the need for more work on

lesson plans. Some concerns were also expressed that including ML questions and practices in the teaching, process might need to be clarified in the classroom. As Burkhard (2008) states, it can be expected that such confusion may occur in innovation initiatives and that it will disappear with time and experience.

The fact that teachers know about the practices facilitates the teaching practices and that they want these practices to be done during the seminar can be considered a sign of their internalization of teaching. However, additional time may be needed in this case, or it can be overcome by including in-class practices within homework studies. Again, teachers' concerns about involving students in the lesson (Table 2, 3) are in line with the result of Staples and Newton (2016) that who "have difficulty in involving students in the discussion." In addition to this, the demands of ML to demand more activities, to experience what has been learned through in-class practices, to increase question writing activities, to create a question and activity pool, to include lesson planning studies rather than theory, to increase discussions, to include the use of technology in the lesson (Table 4) Emphasizing applied studies for the development of both et al. (2013) and shows that there is a need for a change in this direction in the organization of seminar content.

While expressing the possible obstacles to be encountered in implementing the COM (Table 3), teachers generally refer to the concern of educating the curriculum, as stated by Blomhøj and Jense (2007) and Demir et al. As (2017) stated, they emphasized the difficulties required by the examination system and the class crowd. However, this is not related to the Bifocal Teaching Model but applies to almost any innovation initiative. Moreover, no increase in the content will cause teachers to worry about not being able to complete the curriculum in teaching with the COM. Similarly, nowadays, where competencies have gained such importance (Niss et al., 2016; 2017), while it is clear that competencies should take their place in the curriculum, concerns such as completing the curriculum seem unnecessary. It should not be overlooked that it will be a complex and slow process for teachers to try a teaching approach suitable for a new model in the classroom, even in a supportive environment (Schoenfeld, 2010).

When the affective effects of teaching are examined, the thought that these approaches lead to finding mathematics valuable by arousing curiosity, valuing students' thoughts, and revealing the role of mathematics in life (Marks, 2000; Newmann et al., 1992) suggests that the lessons in which ML is integrated will attract the attention of students. It is compatible with the idea that it will increase mathematics achievement. In parallel to this, there are also studies (Bulat, 2023; Karaduman, 2023) reporting positive attitudes of students towards mathematics in the lessons where COM is applied. In these studies, it is stated that students reported positive opinions about enjoying mathematics and valuing mathematics after the training.

"Do you recommend that other mathematics teachers take this training as well? If your answer is yes, explain why." The question, which was asked to the teachers, has two purposes. The first is to test the reliability of the interview content, one of the data collection tools, and the other is to understand the real thoughts of the teachers by obtaining information about the model indirectly. When the opinions expressed by the teachers in this context are examined, it is seen that the findings in Table 5 and the findings in Tables 1 and 3 are consistent. For example, the highest frequency item in Table 3 is "associating mathematics with life" (f=10); It shows parallelism with the expression "associating mathematics with life" (f=7) in Table 5. In the literature, the results related to the benefits of the model in terms of relating mathematics to real life have been shared (Bulat, 2023; Karaduman, 2023). They also evaluated the issues that they emphasized functionally in Table 3 as issues that will contribute to the equipment of the teachers who will retake the seminar. The information in Table 5 and the highlights in Table 3 (learning to patch up questions, teaching with activities, changing perspectives, providing professional development on ML, etc.) overlap to a large extent. This consistency suggests that teachers express their thoughts sincerely and that these statements can be trusted.

Conclusion and Recommendations

This study discusses an in-service teacher training seminar to train teachers who can integrate ML into the teaching process. The seminar's content was created according to the COM. The results showed that the seminar's content and methodology followed in the seminar were suitable for ML teaching. Planned and implemented teacher training seminar teachers; It has produced positive and successful results in planning a lesson by the COM and preparing the modules for the lesson and the contents that make up the modules. Teachers reflected on their statements that they had more detailed information about how they could improve ML. In summary, the participating teachers found the seminar content appropriate, sufficient, applicable, and sustainable in ML teaching. As can be understood from the expressions in Table 3, practice-oriented studies were carried out

throughout the seminar, and teacher initiatives were supported in these applications. They were ensured to act freely in planning the reflections in the focus areas.

As a result, in the practices carried out within the seminar's scope, the "classroom" was considered a living space, and the principle that mathematics is a "matter of thinking and discussion" was always considered. Despite this, for teachers to be well trained in ML;

(i) It is necessary to enrich the teaching with this aspect, taking into account the demands that the applied studies to be carried out in the secondary school mathematics courses are carried out precisely and one-to-one in the seminar environment,

(ii) Providing such resources, taking into account the need for resources such as ML question and activity pool,

(iii) It will become more qualified if the teaching is enriched regarding technological support.

These three items, on which teacher suggestions are concentrated, are not related to a change in the essence of the proposed model but are in the nature of increasing some of the activities in the model, and considering that they can be easily eliminated, it has been concluded that they are valid, applicable and sustainable for mathematics literacy teaching.

Statements of Publication Ethics

This research study complies with research and publishing ethics. The studies involving human participants are reviewed and approved by the … University Ethics Committee (… dated - Number: …).

Researchers' Contribution Rate

Author 1 (%35), Author 2 (%15), Author 3 (%15), Author 4 (15), Author 5 (%5), Author 6 (%5)

Conflict of Interest

The authors declare no conflict of interest.

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Portrait of Rejected Children: The Case of Preschool Years

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Abstract

Social status is a complex and multi-dimensional concept in society. Individuals with different social status have different experiences and assume different roles in society. Social rejection of children can cause both individual and collective problems in the short or long term. It is important to draw attention to the problems experienced by rejected children and raise awareness in society, improve their well-being and enable them to reach their potential. For this reason, the research initially aimed to identify the social status of the children and obtain in-depth information on why they were rejected in their social environment. This study was conducted using qualitative research methodology. The research design included a basic qualitative research design based on an interpretive perspective. The research group consisted of 16 children selected from a classroom that was easily accessible and temporally accessible to the researcher. The data collection process included the classical sociometric situation classification system. This enabled the categorization of children's social status into categories such as "rejected", "popular", and "neglected". Children were also asked to draw portraits of their "least favorite" friends. The drawings were analyzed in depth through one-on-one interviews with the children. The portraits were analyzed through content analysis and the characteristics of rejected children were transformed into themes. Accordingly, four main headings emerged as elements in children's drawings, undesired behaviors, social contact, and expression of emotions. Aggressive behaviors, disturbing behaviors, behaviors associated with autism, gender-based differences, and behaviors perceived as inappropriate in the social environment came to the forefront in the expressions of the rejected children. In addition, children reported that rejected children were often angry or had moods that were not clearly understood. Children also reflected their emotional states in their artworks and did not like to draw friends they did not prefer. In line with these results, some recommendations for institutions, teachers, and families regarding some social status are presented.

Keywords: preschool education, sociometry, drawing, portrait drawing, rejected children

Reddedilen Çocukların Portresi: Okul Öncesi Dönem Örneği

Öz

Sosyal statü, toplumda karmaşık ve çok boyutlu bir kavramdır. Farklı sosyal statülere sahip bireyler farklı deneyimler yaşar ve toplumda farklı roller üstlenirler. Çocukların toplumsal olarak reddedilmesi kısa ya da uzun vadede hem bireysel hem de kolektif sorunlara neden olabilir. Reddedilen çocukların yaşadıkları sorunlara dikkat çekmek ve toplumda farkındalık yaratmak, iyi olma hallerini iyileştirmek ve potansiyellerine ulaşmalarını sağlamak önemlidir. Bu nedenle araştırmada öncelikle çocukların sosyal statülerinin belirlenmesi ve sosyal çevrelerinde neden reddedildiklerine dair derinlemesine bilgi edinilmesi amaçlanmıştır. Bu çalışma, nitel araştırma yöntemi kullanılarak gerçekleştirilmiştir. Araştırma tasarımı, yorumlayıcı bir perspektife dayanan temel nitel bir araştırma tasarımını içermektedir. Araştırma grubu, araştırmacının kolaylıkla ulaşabildiği ve zamansal açıdan erişiminin kolay olduğu bir sınıftan seçilen 16 çocuktan oluşmaktadır. Veri toplama süreci klasik sosyometrik durum sınıflandırma sistemini içermektedir. Bu durum, çocukların sosyal durumlarını "reddedilen", "popüler", "ihmal edilen" gibi kategorilere ayırmayı sağlamıştır. Ayrıca, çocukların "en az sevdikleri" arkadaşlarının portrelerini çizmeleri istenmiştir. Çizimler, çocuklarla birebir gerçekleştirilen görüşmelerle derinlemesine analiz edilmiştir. Portreler, içerik analizi ile incelenmiş ve reddedilen çocukların özellikleri temalara dönüştürülmüştür. Bu doğrultuda çocuk çizimlerindeki unsurlar, istenmeyen davranışlar, sosyal temas ve duyguların ifadesi olarak dört ana başlık ortaya çıkmıştır. Reddedilen çocukların tercih edilmemelerinde sıklıkla saldırgan davranışlar, rahatsızlık veren davranışlar, otizm ile ilişkili davranışlar, cinsiyet temelli farklılıklar, sosyal ortamda uygunsuz olarak algılanan davranışlar çocukların ifadelerinde ön plana çıkmıştır. Ek olarak çocuklar reddedilen çocukların genellikle kızgın ya da net olarak anlaşılmayan duygu durumlarına sahip olduklarını belirtmişlerdir. Çocuklar aynı zamanda kendi sanat ürünlerine de duygu durumlarını yansıtmışlar ve tercih etmedikleri arkadaşlarını çizmekten hoşlanmamışlardır. Bu sonuçlar doğrultusunda kurumlara, öğretmenlere ve ailelere bazı sosyal konumlara ilişkin bazı öneriler sunulmuştur.

Anahtar Sözcükler: okul öncesi eğitim, çizim, sosyometri, portre çizim, reddedilen çocuklar

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INTRODUCTION

School is the place where preschool children experience their first social relationships after their families. With the beginning of preschool education, the social environment that the child will interact with expands with teachers and peers (Ekinci Vural, 2006). The interactions of children in this period shape the structure of peer relationships. Children's characteristics before their social skills affect their peer relationships and form the general structure. Therefore, individual characteristics affect social relations as well as social skills. For children to develop positive peer relationships, attention should be paid to the development of positive social skills as well as personality development. There is evidence that children's early social skills predict peer acceptance in later years (Blandon vd., 2010). From this point of view, there are also studies aimed at developing social skills and competencies necessary for effective interpersonal relationships in children with low social status (Asher & Coie, 1990; Coie & Cillesen, 1993). Positive peer relationships can reduce some problems, while negative peer relationships can increase problem situations. The early years are important in terms of the long and short-term effects of peer relationships and experiencing the first examples. For example, it has been observed that hyperactivity and exposure to peer violence have a significant negative relationship with social position, whereas positive behaviors have positive effects on peer relationships (Gülay, 2009). Children's prosocial behaviors, pragmatic language skills, and gender are related to their social position among their peers (Paulus, 2017). Children who are rejected by their peers miss out on the opportunity to interact with other children and thus fail to acquire social skills. In the following years, they may face problems such as delinquency, depression, and substance abuse (Hay, 2006; Ladd & Burgess, 2001). In addition, the presence of peer-related loneliness in childhood and its continuation over the years shows that it creates an interpersonal stress factor that predisposes children to adolescent depressive symptoms (Qualter vd., 2010). In addition, longitudinal studies suggest that peer rejection in childhood may predict more severe internalizing and externalizing problems in adolescence, especially for both aggressive and rejected boys (Coi, etc, 1995). Negative peer experiences in childhood predict adjustment difficulties in adolescence and adulthood (Mikami, Lerner & Lun, 2010). On the other hand, socially accepted children tended to have disabilities that were less likely to affect social problem solving and emotional regulation (Odom, etc, 2006). Behaviorally, rejected children can be uncommunicative, rebellious, and less friendly, with some displaying hypersensitivity due to feelings of insecurity. Observations have categorized the maladjusted behaviors of rejected children into groups such as Impulsive Aggression, Immaturity/Depression, Withdrawn/Distractible, Hostile/Aggressive, and Psychomotor Difficulties (Morgan, 1978; Pemberton & Benady, 1973) For this reason, it is critical to support children with low acceptance in the preschool years, that is, children with negative social positions, and to create positive changes for their social position by improving their social skills (Choi & Kim, 2003). The undeniable importance of social position in early years makes it valuable to investigate the determinants of social position in preschool classrooms. Since research has shown the long-term effects of peer relationships, it is important to evaluate the sources of positive or negative peer relationships in terms of both prevention and social skill development practices. For this reason, it is necessary to examine their relationships with their peers and the reasons for them from primary sources by providing them with the most appropriate methods of expression.

Accordingly, this study aims to determine the social status of children in a classroom and to examine the social position of rejected children in depth through art. Children were given the opportunity to express themselves through art. Thus, detailed information was obtained on why rejected children are in this position. According to Fox and Schirrmacher (2012), art is an effective and unique method that allows children to express themselves. Therefore, it was envisaged that art would be an appropriate data collection method for why children prefer their peers, especially because it allows them to express themselves. The art products created by the children can also be handled under the title of personal documents from the document analysis method put forward by Merriam (2015). Here, the participants' works are evaluated. Similarly, Mills (2003) considers almost every conceivable product created by the participants as data and states that the classroom environment is a very rich source of data for this. This study aims to reveal peer preferences during preschool period and explain the reasons for these preferences; in terms of data collection methods, children's self-expression of their preferences in accordance with their development as a primary source provides unbiased information about negative peer preferences.

METHOD

Research Design

Qualitative research method was used in this study. Qualitative method is a research methodology that focuses on understanding and interpreting subjective experiences and meanings in a holistic and in-depth manner (Koopman, 2017). According to Merriam (2015), a basic qualitative research design was applied from an interpretive perspective.

***Study Group*:** Within the scope of the research, the convenience sampling method was preferred. The convenience sampling method refers to situations in which groups that are easy to reach and easy for the researcher to access in terms of time and transportation are selected (Yıldırım & Şimşek, 2021). In this direction, a classroom in the school where the researcher conducts Teaching Practice I and II courses and 16 children in this classroom were selected as the study group. Since it was necessary for the sociometry application for the children to know each other very well, it was determined as a criterion that the children had been in the classroom since the beginning of the academic year. One of the children was not included in the study because he started school in the second semester and was not well known by his friends. 5 of the children in the study group were girls and 10 were boys. The oldest of these children was born in November 2016 and the youngest was born in February 2018. In this case, the ages of the children vary between 61 months and 76 months. It is thought that the fact that the children know the researcher will facilitate the data collection process by their developmental characteristics and that they will give sincere answers. First of all, permission was obtained from the families of the children to participate in the study. In addition, permission was also obtained from the children for their voluntary participation in the data collection process.

Data Collection

Sociometry: The classical sociometric status classification system proposed by Coie et al. (1982) was used in the study. According to this system, the students were asked to choose 3 friends they like most and 3 friends they like least. Considering their development, they were shown a table with photographs of their classmates and were allowed to choose among their friends. With this technique, a measurement could be made in the classroom and the social status of the children was evaluated in 5 different areas within the framework of the scores they received. After the choices were made, like most and like least scores were calculated for each child. The calculated scores were standardized and converted into z scores. Then, Social Impact (SI) and Social Preference (SP) scores were calculated for each child. Social preference was calculated as the difference between like most and like least scores, and social impact was calculated as the sum of these scores (Coie et al., 1982). The criteria used to determine social status were:

SP> 1.0; L>O, D<O is popular,

SP<-l,0; L<O, rejected if D>O,

SI<-1.0; L<O, D<O is neglected (excluded),

SI>1.0; L>O, D>O is controversial (Gülay Ogelman, 2018).

Portraits of Children: After this technique was applied for each child in the class, a one-to-one drawing study was conducted with each child in the same week. Children were asked to draw a portrait of their “like least” friend in line with their answers to the sociometry technique. Children were allowed to use any of the paints they used in the classroom. The drawings were conducted one-on-one in an isolated environment outside the classroom. After the drawings were completed, each child was interviewed about the portraits. Children were asked to describe the drawings and their opinions about their “like least” friend were learned in depth. Children's drawings and their explanations about their drawings were recorded. Children's drawings and interviews lasted between 15-30 minutes.

Data Analysis

First of all, the frequencies of children's peer preferences were revealed. Then, as described in the data collection tools, children's social status were determined based on their z scores. Accordingly, the portraits of children whose social status was "rejected" as drawn by their friends were evaluated. Interviews about children's portraits were content analyzed. In line with the content analysis, ideas about rejected children were brought together in themes and presented. The basic process in content analysis is to bring together similar data within the framework of certain concepts and themes and to interpret them by organizing them in an understandable way (Yıldırım ve Şimşek, 2021). In order to increase the reliability of the content analysis, the coding was checked by two more preschool education scholars.

Research Ethics

In this study, permission was obtained from the ethics committee, parents and children participating in the study. At the beginning of the process, the permission of the university and the research description were shared with the families. After obtaining permission from the parents, permission to participate in the process was requested from the children during one-to-one interviews. The researcher explained to the children what they were going to do and asked them to draw a smiley face on the form if they wanted to do these activities and the researcher signed the same form.

FINDINGS

This section first presents descriptive analyses of children's negative peer preferences. Then, the characteristics of rejected children that emerged from the content analysis were presented as themes. At the same time, the prominent elements in the children's drawings were also evaluated. The table below shows the 3 least favorite friends of each child.

Table 1. Children's "like least" Friend Choices

Children	First One	Second One	Third One
P1	P7	P3	P9
P2	-	-	-
P3	P11	P4	P7
P4	P11	P8	P15
P5	P11	P2	P4
P6	P4	P2	P10
P7	P15	-	-
P8	P2	P4	P7
P9	P11	P10	P2
P10	P4	P7	P1
P11	P7	P4	P2
P12	P7	P2	P1
P13	P2	P4	P7
P14	P7	P2	P10
P15	P11	-	-

As seen in Table 1, only two children made one choice in peer preferences. Although the researcher tried to ask in different ways during the interview, both children stated that there was only one friend they did not like. Child coded P2 was diagnosed with autism and had problems with receptive and expressive language. For this reason, a reliable answer could not be obtained from him and he was not included in the analysis process. He could only say the name of his favorite friend and repeated it continuously. In light of the data shown in Table 1, the social status of the children was determined based on their z scores as described in the data collection tools.

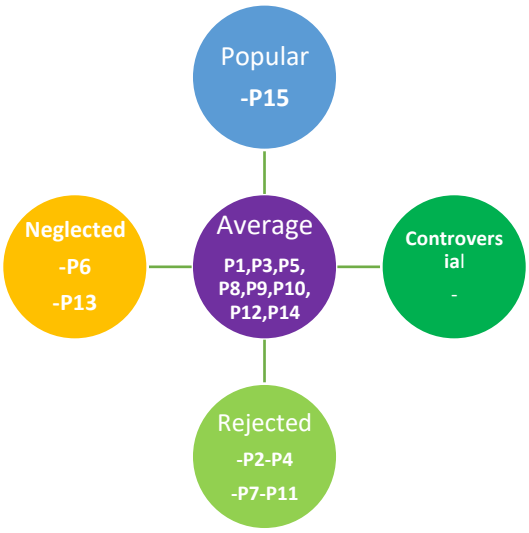

Figure 1. Social status of children

The social status of the children is shown in Figure 1. There is no child in the class whose social status is controversial. One child has a popular social status, while two of them are neglected. Finally, the 4 children who are the subject of this research have rejection status. The remaining children (N=8) have an average social status.

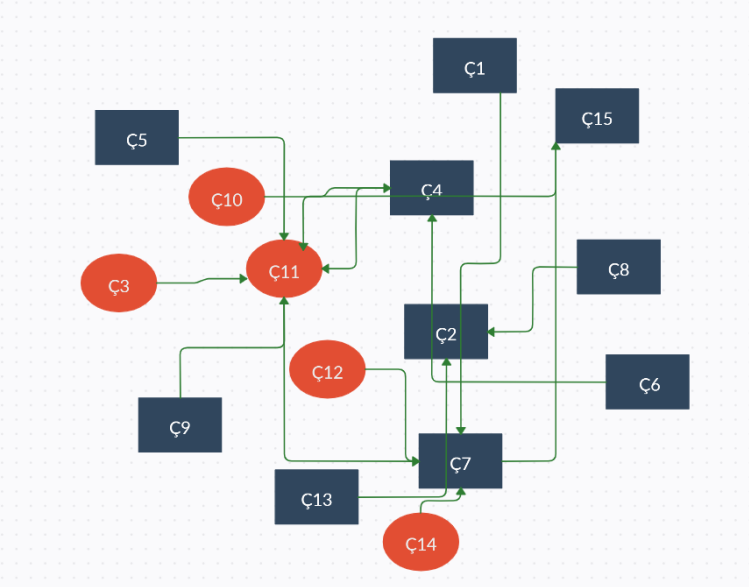

Figure 2. Children's first “like least” friend preferences

Figure 2 above shows the children's first choice among their least favorite friends. Among the rejected children, it was observed that P2 and P4 were the first choices of only two children. P7 was chosen as the first choice by four children. P11 was chosen as the first choice by five of his friends. P11 was the child who was the least frequently but the most frequently selected as the first choice among the rejected children (Table 1 and Figure 2). In Figure 2, the children represented by rectangles are boys and the children represented by ellipses are girls.

Elements Prominent in the Drawings

As mentioned before, there are 15 children in the class. One of these children did not draw (child coded P2 who was diagnosed with autism). In addition, no information could be obtained from him about the friends he disliked. Secondly, the social status of the child whose portrait was drawn by P7 was determined as "popular". As a result, all of the remaining 13 drawings belong to children who were rejected because they were shown as first-degree “like least” children. Some of the portraits of rejected children are shown below.

Figure 3. Examples of P2's portraits

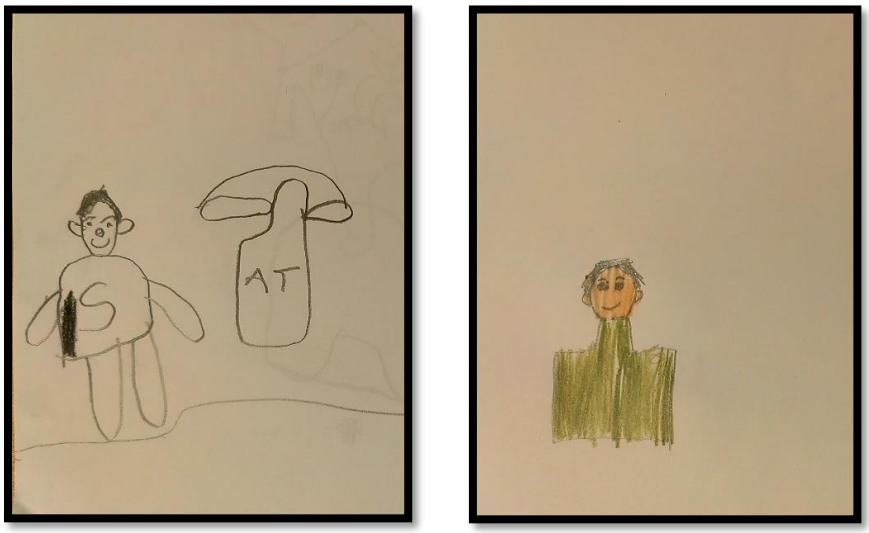

Figure 4. Examples of P4's portraits

Figure 5. Examples of P7's portraits

Figure 6. Examples of P11's portraits

When the children's expressions through the drawings were analyzed, some elements stood out clearly. Four basic categories can be identified when interpreting the codes. These are parts of the body, clothes, and accessories, detailed descriptions, and the use of color.

In the expressions used by the children in their drawings and in their explanations of how they drew, it was observed that they focused on the body of the person due to the nature of portrait drawing. It was seen that they emphasized the hair the most in the parts related to the body. While the face was seen in every drawing, the eyes, ears, and mouth were often emphasized in the parts of the face, while the nose, eyelashes, lips, and eyebrows were rarely seen. Fewer portraits included the lower part of the body. These usually included the hands and feet, but there were also children who verbally emphasized the details of the knees and arms.

Another category that stands out in the drawings is clothes. T-shirts are the most frequently mentioned in the drawings. While more than half of the children used t-shirts in their portrait drawings, very few mentioned shoes, coats, hats, and pants.

It was also observed that children used some details in the drawings. These are especially the details used to make the drawing realistic. For example, transferring the pattern on the child's t-shirt to the drawing is an example of an effort to convey the portrait realistically. Apart from these, paying attention to the color of the clothes worn by the children and mentioning details such as eyelashes and lips are seen in the drawings. Another detail used to create a photographic effect is that some children place the portrait in a frame.

Finally, another element that stands out in the drawings is the use of color. Although children were given the opportunity to use any color they wanted, remarkably, the majority of the children preferred to use pencils. Only 5 of the children preferred to use color in their drawings. The children who used color first completed the drawing with pencil and then preferred to paint some parts such as t-shirts. All of these coloring activities were used to create a realistic effect. For example, painting the face of the drawn portrait in skin color.

Undesired Behavior

Three categories emerged under this theme. The first is uncomfortable contact. This can also be described as aggressive behavior in general. When asked why rejected children were not preferred, hitting and pushing behaviors came to the fore. In this context, although to a lesser extent, children reported squeezing, pulling, and damaging games and toys. For example, in the portrait drawing of P2; *P13: Sometimes he holds my arm like this (shows by squeezing his arm). I don't like it either.* P13 uses these words to explain why he does not like his friend.

Another category is disturbing behavior. This category includes behaviors that do not involve contact, but cause discomfort to the environment and the person. For example, the most commonly mentioned behavior in this category is "talking. Being uncomfortable with talking is more likely to occur when it is preferred not to talk, such as when the teacher is reading a story. The following disturbing behaviors that follow talking are annoying the teacher, misinterpreting instructions, misbehaving, and being a brat. Most of these behaviors are also behaviors

that make it difficult for the teacher to manage the classroom. Therefore, it is reasonable to assume that the situations in which children are most disturbed are also the moments in which classroom management becomes difficult. Behaviors that disrupt the social order suggest that children's peer preferences are affected. As an example of this situation, while describing the portrait of P7, "*P1: Some of them, when we come to school, then when we finish eating, we switch to reading books. Then they do a lot of slap-dab, I mean, they disturb me and my teacher gets angry with them*".

Autism-related behaviors are a special category that stands out in this context. There are some disturbing behaviors that are expressed specifically for the child diagnosed with autism in the classroom and are not expressed for any other child. Repetitive behaviors can be given as an example of this. As an example, P13 said, "*For example, he walks around like this (pointing), one day he said poo poo poo poo. He says poop poop poop all the time*." Other disturbing behaviors mentioned included raising voices and inappropriately addressing teachers or friends. There were also behaviors that children referred to as "spoiling" that they did not know how to define. For example, P2's repeating some incomprehensible words to himself and not responding to the calls of others were referred to as "spoiling".

Social Contact

One of the categories that emerges under social contact is gender. It was observed that children emphasized gender with a strong expression regarding the friends they disliked. For example, a child who was very enthusiastic when he heard that he was going to draw about his friends and even wanted to take his drawing home, was very disappointed when he received instructions to draw his friend of the opposite sex. Before he started drawing, he showed resistance and the following dialogues took place (the child in this dialogue is also a rejected child).

P4: Am i a girl (reproachful and reluctant). I want a boy, a boy, a boy.

P4: Ouch, why did you come P11, am I a girl, ouch, ouch

P4: But I won't take the paper I drew her on.

During the interview after the drawing process, the children also stated that their friends with rejected status had, particularly "sexist" attitudes. For example; "*P12: No, he never plays with girls."* Not only in plays, but also in the daily processes in the classroom, the children stated that they preferred friends of their own gender and therefore could not make friends. For example, *P10: "He never sits next to girls, he always sits next to boys*." Another notable finding under this heading is that 3 of the rejected children were boys and 1 was a girl. The children reported as having "sexist" behavior were all boys. No data was recorded on the rejected girl child that she did not prefer boys.

Social preferences is another heading that emerged in this theme. Social preferences can generally be expressed as an orientation in the classroom. For example, the most common expression under this category is the preference for different games and toys. Similarly, activity preferences can also be considered in this context, for example; "*P15: Because I play soccer, she plays other games*." Within the scope of game and toy preference, a specific finding was obtained for the child diagnosed with autism. It was observed that P2 was not preferred by his friends because he did not play with toys or participate in games. Another finding was that children did not sit next to each other. The children stated that they did not communicate with each other because they never sat next to each other in the classroom. The teacher was informed that children sitting next to each other are often related to the order of the classroom, but it is also a flexible situation.

Another category that emerges in the social context can be expressed as inappropriate behavior. These behaviors occurred less frequently than other categories. However, since it could not be included under other categories, it was evaluated as a separate issue. Another finding similar to the preference for games and toys is not sharing games and toys. Children's preferences are affected by the fact that they do not include each other in the games they set up, or that they have problems sharing the same toy when they want to play with the same toy. Blocking each other's requests is also one of the behaviors that children exhibit toward friends they do not prefer. A notable finding, expressed by only one child, was the display of negative behaviors when warned about behaviors perceived as wrong. These negative behaviors include complaining to the teacher or threatening the person and holding a grudge because of the warning. As an example of this dialog, P6: *"He's lying. I mean, he told the teacher, mmmm, I didn't say I would hit you, but he said P6 would hit me.*

Similarly to other themes, the findings specific to children with autism are also present under this heading. Children who could not understand the topic of autism expressed their inability to communicate with P2 as "he is younger than us" and "he cannot think like us". At the same time, children stated that they tried to support P2 in

the classroom, but these efforts were not reciprocated. An example of this expression is the following *P8: I show him a little bit, but he doesn't understand*.

Expression of Emotion

Emotional state emerged in the data in two different ways. The first is the emotional state of the children interviewed towards their "least like" friends. The second is to understand the emotional state of the child being talked about. Two main situations were identified in relation to the emotional states felt by their friends. The most frequently mentioned state is "being angry". The children's primary interpretation was that they were generally angry about the emotional state of the rejected children. Another interpretation of the emotions is that they are not able to "understand" the emotions of these children. For example, P5 said directly about P11: "*I don't understand what she thinks and what she feels"*.

The emotions that children directed at their least favorite friends were a disappointment at having to draw that person and sloppy drawing. Another finding was that the children were generally indifferent to what their least favorite friend was feeling. One of the children used unhappy facial expressions to decorate the drawing of the disliked friend. He explained this as follows: "*P1: I wanted to draw an unhappy face here because I don't like P7"*. One of the children was reluctant to draw the portrait and said that he did not want to draw at all. As can be seen, the children's feelings towards their disliked friends were generally negative. Only one child described a positive emotion towards a disliked friend.

DISCUSSION AND CONCLUSION

The aim of this study was to identify children's peer preferences and to investigate the reasons for negative peer preferences. To this end, children were given the opportunity to express themselves through drawing. After taking sociometric measurements, the children drew portraits of their negative peer preferences.

As a result, it was found that in a class of 15 children, 4 children had a rejected position after sociometric evaluation. Of these children, 1 was a girl and 3 were boys, and 1 of the boys was diagnosed with autism. Among these children, the child who was reported as the first choice among the rejected friends was a girl (P11). When analyzing the children's drawings, four basic categories can be identified when interpreting the codes. These are body parts, clothes and accessories, detailed descriptions and the use of colors. It is a normal result of the nature of portraiture that children usually focus on the face and facial organs. In the drawings, it is noticeable that very few children prefer the use of color. In general, only pencil was used in the drawings. The children generally showed a realistic attitude in their portrait drawings. Both the effort to use details and the effort to create a realistic composition can be explained by the fact that the children have passed through the developmental stage of realistic drawing (Lowenfeld & Brittain, 1987).

One of the themes that emerged about the rejected children was undesired behaviors and there were 3 categories under this theme (uncomfortable contact, disturbing behaviors, autism-related behaviors) The first category included mostly aggressive behaviors, and this is consistent with the literature. It has been observed that children with aggressive behaviors are rejected by their peers and these two variables are related (Erol & Gülay Ogelman, 2020; Monks, Ortega Ruiz, & Torrado Val, 2002; Paulus, 2017). It has also been observed that boys exhibit more aggressive behaviors in kindergarten and these behaviors negatively affect peer status (Keane & Calkins, 2004). This finding is also consistent with the fact that the majority of rejected children are boys. According to teachers' opinions, in many preschool classrooms, classroom rules are determined at the beginning of the semester in consultation with children, and classroom needs, the requirements of social life, and disruptions in the classroom are taken into consideration in determining the rules. For example, there are rules such as being quiet during activities and not damaging toys (Saltali & Arslan, 2013). In early childhood education, children's daily practices largely revolve around order and discipline (Odenbring, 2014). A socialized individual behaves in accordance with the rules and expectations of the society in which he/she lives (Çağdaş & Seçer, 2002). The classroom is also a small social space for children. Therefore, behaviors that disrupt the classroom order can be considered as an obstacle to socialization. Behaviors that disrupt classroom order can be considered as a result of not being preferred by their peers.

The categories addressed in relation to the social contact exhibited by rejected children were gender, social preferences, and inappropriate behavior. Gender has a significant impact on children's friendships. Some studies found that Friendships were found to be more likely to occur between same-gender peers (Hooijsma, etc, 2020). Research shows that young children typically have same-sex friendships, but there is growing recognition of gender-integrated friendships in schools and the benefits of gender integration for social-emotional development

(Mulvey, etc, 2020). Gender plays a role in children's friendships, as children tend to be similar to their friends in terms of gender and participation in gender-type activities (Braun and Davidson, 2017; Braun, 2014). Individual differences in friendships with children of the other gender can reduce gender bias and lead to more positive attitudes and influences when interacting with the other gender (Halim vd., 2021).

In this study, children's social preferences were found to be a reason for peer preference. Social preference was also found to be independent of gender. The data obtained showed that gender was also a factor in children's preferences for games, toys and seating in the classroom. This situation also supports the studies on the effect of gender on children's play and toy preferences (Carter & Levy, 1988; Özdemir, 2015; Özyürek, 2015; Sezici & Yiğit, 2019). Since this situation is perceived and maintained in a similar way by the community, it is also reflected on children (King vd., 2020). Sharing behavior is important within the scope of inappropriate behavior, which emerges as another subcategory in social contact. It was found that children did not prefer friends who did not share their toys. Similarly, research shows that sharing is an important aspect of social competence and plays an important role in children's peer acceptance and that children are more likely to be accepted by their peers (Paulus & Moore, 2014). Children who are liked by their classmates are more likely to share more with their best friends, while disliked children share less with all recipients (Asscheman vd., 2020). Children's social status was found to be positively related to their sharing behavior in their own group (Sabato & Kogut, 2021). Therefore, these results are supported by the research results.

The fact that a child who was rejected by his/her friends had autism was also a striking finding in the findings. Research has shown that the social status of children with autism is generally rejected among their peers (Metin vd., 2015). In another study, it was stated that the child with autism had a neglected status and similar to this study, children with normal development thought that the child with autism was younger than them (Menteş & Arnas, 2021). Parents of children with autism reported problem behaviors and repetitive behaviors (Hall & Graff, 2012; Töret vd., 2014). In the current study, they stated that the children also made meaningless sounds and made repetitive movements and that they were disturbed by this. Families of children with autism stated that they encountered hostile attitudes when their children exhibited behaviors considered inappropriate in a public space (Gray, 2002). In addition, since the child with autism has limited verbal communication skills, making incomprehensible sounds and repeating certain words are among the reasons for the negative peer preference. A study found that children with poorer verbal communication proficiency were more likely to be rejected by their peers, especially for boys (Van der Wilt, etc, 2016).

According to the results of this study, children generally described the emotional state of rejected children as angry. There are also results that the emotions of rejected children are not understood. Research has shown that rejected children experience anxiety, sadness and anger due to their rejection (Nergaard, 2020). Therefore, it can be thought that the consequences of mood create a cycle in the rejection process. Being angry is also associated with aggressive behaviors. The fact that rejected children are described with angry mood also supports the finding that these children also show aggressive behaviors. The results also show that children are not happy drawing friends they do not like.

This study aims to explain in detail the reasons why rejected children have this social status. The results show that studies on autism awareness of children with normal development should be planned. The social structure in the classroom should take various measures to support the inclusion of students and families and teacher training should be planned for this. In addition to awareness-raising activities on autism, programs to improve children's social competencies should be integrated into the preschool education program. Teachers should be provided with classroom management strategies that will strengthen children's social skills through in-service training. One of the most frequently encountered findings in the results of this research was gender. Studies for children, teachers, and families should be planned to minimize the negative effects of gender roles, which come to the forefront in children's play-toy preferences and friend choices, on social communication and interaction. Researchers can conduct detailed observations of rejected children during free play times and activities to explore the sources in more depth. In addition, it can be observed whether teachers have an impact on the status of rejected children. They can conduct experimental studies to identify effective intervention strategies for rejected children and evaluate the effects of these strategies on change in social status. They can conduct experimental studies to identify effective intervention strategies for rejected children and evaluate the effects of these strategies on change in social status. Longitudinal studies can be conducted to monitor and evaluate changes in children's social status over the long term. Identify the risk factors to which children are exposed and investigate how these factors affect them and ways in which they can be changed.

Limitations

This study is limited to the children who participated in the study in the spring semester of 2023. The data collected in the study is limited to the children's interviews and the answers they gave in the sociometry.

Conflict of Interest

There is no conflict of interest in this research.

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Investigation of Secondary School Students' Perceptions and Attitudes Towards Law and Justice Course According to Family Income-Level Variable

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Abstract

The sample group of this research, which was conducted to examine the perceptions and attitudes of students towards the Law and Justice course, which is given as an elective-course in secondary schools, according to family income level and to decipher the relationship between them, consists of various secondary school students located within the administrative boundaries of Sultanbeyli district. The "Law and Justice Course Content and Structure Questionnaire" was used as a data collection tool in the research. The research data were transferred to the computer environment with the help of the SPSS program; frequency, percentage, mean, standard deviation, and ANOVA tests were analyzed; a quantitative but not experimental descriptive relational research model was designed. According to the results obtained from the research findings; the difference between the student's perceptions of the Law and Justice course and the law and the family monthly income-level variables was not significant, but the difference between their attitudes towards the content of the Law and Justice course and their family monthly income level was found to be significant. The results obtained in the research were also compared with those from previous studies. Accordingly, various suggestions have been made that student should visit places such as courthouses, police stations, and law offices where legal issues are handled concretely and that teachers should try to homogenizing the different socio-economic statuses of the students during the lesson.

Keywords: Perception, monthly income, Law and Justice course, secondary school students.

Ortaokul Öğrencilerinin Hukuk ve Adalet Dersine Yönelik Algı ve Tutumlarının Aile Gelir Düzeyi Değişkenine Göre İncelenmesi

Öz

Ortaokullarda seçmeli ders olarak verilen Hukuk ve Adalet dersine yönelik öğrencilerin algı ve tutumlarının aile gelir düzeyine göre incelenmesi ve aralarındaki ilişkinin tespit edilmesine yönelik gerçekleştirilen bu araştırmanın örneklem grubunu Sultanbeyli ilçesi idari sınırları içerisinde yer alan çeşitli ortaokul öğrencileri oluşturmaktadır. Araştırmada veri toplama aracı olarak "Hukuk ve Adalet Dersinin İçeriği ve Yapısı Anketi" kullanılmıştır. Araştırma verileri; SPSS programı yardımı ile bilgisayar ortamına aktarılmış; frekans, yüzde, ortalama, standart sapma ve ANOVA testi kullanılarak çözümlenmiş; nicel olan lakin deneysel olmayan 'betimsel ilişkisel araştırma modeli' ile desenlenmiştir. Araştırma bulgularından elde edilen sonuçlara göre; öğrencilerin, Hukuk ve Adalet dersine ve hukuka yönelik algıları ile aile aylık gelir düzeyi değişkenleri arasındaki fark anlamlı bulunmamış fakat Hukuk ve Adalet dersinin içeriğine ilişkin tutumları ile aile aylık gelir düzeyi düzeyleri arasındaki fark anlamlı bulunmuştur. Araştırmada elde sonuçlar önceki çalışmalarla da karşılaştırılmıştır. Buna göre öğrencilerin öğretmenleri eşliğinde, hukuki konuların somut bir şekilde işlendiği adliye, polis merkezi ve hukuk büroları gibi mekanlara ziyaretlerinin yapılması ve öğretmenlerin ders esnasında öğrencilerin sahip olduğu farklı sosyo-ekonomik durumlarının homojenleştirilmesine yönelik uğraş vermesi gerektiğine dair çeşitli önerilerde bulunulmuştur.

Anahtar Sözcükler: Algı, aylık gelir, Hukuk ve Adalet dersi, ortaokul öğrencileri.

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INTRODUCTION

As the income level of societies increases with economic development, education, culture, sports, law, art, etc. people will inevitably achieve success in their fields and be happy. As an example of this situation, Diener and Seligman (2004) stated that people are more successful and happier in their daily lives due to adherence to social life rules and ease of participating in various cultural and artistic activities in societies with a high average income. When we assume that money (material income) is an important factor in people's happiness and success levels (Baysal, 2017), it is also possible to say that people with high material incomes are happier and more successful (Diener and Biswas-Diener, 2002; Köksal and Şahin, 2015). Thus, meeting their needs is material income use they have the most important tool that individuals (Sebele, 2010). Because of this, in societies with high material income, individuals do not have problems in providing their daily basic needs and are interested in arts, sports, entertainment, education, technology, etc. they have an important comfort zone in terms of personal development because they can follow all the developments in the fields in the user dimension (Easterlin, 1974).

In societies with high per capita national income, the level of compliance with written legal rules and social norms established by the state administration is higher than in societies with lower per capita national incomes (Levin et al., 2011; Seval, 2019). According to the data in the report prepared by the World Justice Project in 2020, which investigates the principle of the rule of law and adherence to the law of various countries, the countries in the highest income group in terms of national income per capita (Singapore, Denmark, Sweden, Norway et al.) countries with the highest scores in terms of the rule of law and adherence to the law (Norway, Denmark, Singapore, Sweden, etc.) it has been understood that it is (Öngören and Zaman, 2021; WJP, 2020). According to many studies conducted (Alıcı and Van, 2016; Benenson, 2007; Feld and Voigt, 2003; Levin et al., 2011; Levine, 1998; Seval, 2019; Tunçer et al., 2022), the fact that the income situation affects individuals in terms of the sense of law and justice emerges. Countries who are aware of the situation in question, especially basic education students in education programs oriented to grow up with an awareness of law and justice and the rule of law sure to be conscious of social studies and citizenship classes, and especially are often involved in issues such as training programs organized for law (Associate, 2017; King, 1991; Lasswell and McDougal, 1942; Yosso, 2005). For example, the Civics and Citizenship education for children between the ages of 11 and 16 in the UK also aims to gain basic knowledge and skills related to law and justice (Mattei and Broeks, 2018). In primary schools since 1968 and taught in secondary schools, since 1973 began training programs organized for Social Studies courses in active conscious of the requirements of being a citizen of law and Justice knowledge and skills (change and continuity detection, critical thinking, research, environmental literacy, entrepreneurship, digital literacy, empathy, financial literacy, map literacy, observation, legal literacy, etc.) it is aimed to gain in Türkiye (Çiydem and Kaymakcı, 2021; Katılmış et al., 2010). Additionally, the Human Rights, Citizenship and Democracy course for law, justice, democracy, and citizenship education for students in the fourth grade of primary school in Turkey and secondary school sixth, seventh, and eighth-grade the ‘Law and Justice course’, which is an elective-course, is also taught in the classroom levels (Aycıl, 2017).

This research examines the perceptions and attitudes of students toward the ‘Law and Justice course’, which is given as an elective-course in secondary schools, according to family income level, and to decipher the relationship between them. Considering national income per capita affects the rule of law and the level of adherence to the law (Ongoren and Zaman, 2021; WJP, 2020); material income affects individuals’ sense of law and justice (Benenson, 2007; Tuncer et al., 2022); It is thought that the examination of students’ perceptions and attitudes towards the ‘Law and Justice course’ according to family income level will provide enlightening and exploratory results for law and social sciences educators. Additionally, it is assumed that the results to be obtained from the research will contribute to the studies to be conducted to improve the perceptions and attitudes of disadvantaged groups toward Law and Justice education.

Perception and Attitude through Law and Justice Education

Perception; In cognitive sciences and psychology, it means the reception, evaluation, selection, and regulation of sensory information. According to Atkinson et al. (1995), perception is the process of organization and interpretation of stimulus images in the environment. In the end, the perception appears by collecting sensory data together into an entire pattern. Science is a process of perception. Perception in any human being is realized because of making sense of the stimulus that goes to the brain through the eye (Beyoğlu, 2015).

However, attitude is the set of beliefs that affect the state and movements of the individual. An attitude consists of three components: cognitive, affective, and behavioral (Acar and Ordu, 2022). In the cognitive stage, awareness, knowledge, and beliefs; in the affective stage, desire, liking, and liking; in the behavioral stage, the elements of action, experimentation, and adoption are included. The three basic components of attitude (affective, cognitive, and behavioral) also interact with each other (Çöllü and Öztürk, 2006). Additionally, according to Reid (2006), a change in attitude occurs only if a change occurs in at least one of the three basic components.

One of the most important conditions for the effective and efficient delivery of law and justice education and legal literacy education is that the students have a positive perception and attitude toward the 'Law and Justice course'. Because students' perceptions and attitudes toward the 'Law and Justice course' affect their learning of the 'Law and Justice course', but also affect their use of the knowledge and skills learned in the course in their daily lives (Alıcı and Van, 2016). However, students' perceptions and attitudes toward the 'Law and Justice course' will affect their level of readiness for the course, so it will become difficult for students with negative perceptions and attitudes to learn the subjects of the course and gain knowledge and skills (Irşi, 2017). As a matter of fact, Alkayış (2019) and Doğan (2020) focused on the perceptions and attitudes of secondary school students on Law and Justice; They stated that their students who had sufficient readiness for law and justice have a positive attitude toward 'Law and Justice course'. Especially the legal terms contained in the Law and Justice textbook (constitution, law, state, public interest, etc.) suitability of students according to their cognitive level is important. Because it will be easier for the student to focus on the lesson and it will be ensured that he will gain knowledge and skills at the end of the lesson. Indeed, the report of ICCS (International Civic and Citizenship Study) for secondary school students published in 2010 (Schulz et al., 2010); determined that the formation of the competence to understand legal terms in individuals and learning has emerged as necessary in daily life in the past affects the positive aspects of their attitudes toward Law and Citizenship education.

Students' perceptions and attitudes about legal literacy and 'Law and Justice courses have generally been tried to be measured by the questionnaire, questionnaire, and word association tests (Aycıl, 2017; Doğan, 2020; Snook et al., 2016). However, in perception and attitude studies conducted for primary and secondary school students, the development of questionnaires, questionnaires, and word association tests appropriate to the cognitive levels of students is the most important condition for the research to be consistent, valid, and reliable. Decker and Brady (2015) used legal literacy and using the word place test developed by Doğan (2020) about the 'Law and Justice course', according to their common parts; They stated that it is important for Law and Social Studies educators to determine the perceptions and attitudes of students about the law and justice education and to take the necessary measures in school environments and lessons, through the necessary education and training. Additionally, Alıcı and Van (2016), Alkayış (2019), Aycıl (2017), and Irşi (2017) conducted different variables related to the 'Law and Justice course' of secondary school students (class, gender, family income, etc.) for that purpose in their research have developed questionnaires that measure their perceptions and attitudes in the context of. Since the perceptions and attitudes of secondary school students towards the 'Law and Justice course' in the context of family income level were examined in this research, the "Content and Structure of the Law and Justice Course" questionnaire was developed and used by taking inspiration from the questionnaire items used by Aycıl (2016), Alkayış (2019), Aycıl (2017) and Irşi (2017) in their research.

The Relationship of Students' Perceptions and Attitudes toward Family Income level and Law and Justice Course

Studies show that family monthly income is an effective variable on students' legal literacy and perceptions and attitudes toward law and justice. For example, Balbağ et al., (2019), who discussed the family income situation in terms of the possibility of one's supply of products, stated that there is a positive relationship between the family income of the students and their use of technology products and that as the frequency of use of technology products increases, students' justice tendencies differ and decrease. Indeed, Benenson et al. (2007) also stated in their research that children's behavioral development is in the interaction with their socio-economic level of development. Alkayış (2019) and Aycıl (2017) stated that the monthly income level of student families decreases during the structured perception and attitude evaluation of students and teachers taking 'Law and Justice course's, similar to that evaluation, Aycıl, and Sönmez (2018) stated that there is a significant relationship between the monthly income level of the student's families and their perceptions and attitudes toward the 'Law and Justice course'.

Research Questions

When the literature is examined, it is seen that there are few studies on the legal and justice values and legal literacy of secondary school students (Alıcı and Van, 2016; Aycıl, 2017; Elbay, 2020; Irşi, 2017; Öngören and Nurdoğan, 2023; Öngören, 2023). For this reason, it is also important to conduct research on the value of justice, which is one of the basic values in secondary school education programs, and to make various arrangements in education programs according to research results and recommendations. Therefore, this research, which examines the perceptions and attitudes of secondary school students toward the 'Law and Justice course' according to their family income level, is expected to contribute to the field. For the research, the following research questions were developed and answers were sought;

1.What is the level of perception of student families toward the 'Law and Justice course' and law with the variable of monthly income level?

2.What is the attitude of the student families regarding the monthly income-level variable and the content of the 'Law and Justice course'?

3.What is the attitude of the student families about the monthly income-level variable and the structure and processing of the 'Law and Justice course?

METHOD

Research Design

This research was carried out with quantitative data as it was aimed to decipher the interaction between the monthly income level of the student's families and their perceptions and attitudes toward the 'Law and Justice course'. As a matter of fact, the quantitative research method, which is a deductive, objective, and positivist research method, also reveals the personal opinions and experiences of people who have their own (Bryman, 2012: 715; Merriam, 1998). Additionally, since the research was carried out to determine the relationship between family income levels and students' perceptions, attitudes, theoretical knowledge, and achievement levels toward the 'Law and Justice course', Therefore, it was designed with a quantitative-only non-experimental descriptive relational research model (Creswell, 2014). The data obtained in this context were analyzed using mean, standard deviation, frequency, percentage, and ANOVA tests with the help of the SPSS 26 program.

Participants

The participants of the research consist of secondary school students who have previously taken or are currently taking the 'Law and Justice course'. This research was conducted in Istanbul, where the researcher resides, to conduct it healthily in terms of the data collection process. The case study method not only speeds up research and makes it more practical, but also reduces costs. Moreover, working with a familiar sample may be seen as easier and more practical for some researchers. For these reasons, researchers may choose to include an easily accessible group in their research. In qualitative research, cost and accessibility are important factors to consider when making sampling decisions (Karataş, 2015; Yıldırım ve Şimşek, 2021). As a result, the research group was selected based on the principle of easy accessibility. For the research, in terms of household income of the poorest counties evaluated and Şahinoglu (2020) household income Istanbul Research in 2017, according to data from the most counties with low household incomes Sultanbeyli (2172 ₺) secondary schools in the borough were chosen as a research area. In this context, the official permissions required for the research to be conducted were obtained from the Sultanbeyli District Directorate of National Education, and the names of the schools where Law and Justice's courses were given in the 2020–2021 and 2021–2022 Education Periods in the Sultanbeyli district. The schools identified according to the Personal Data Protection Law No. 6698 were coded by giving various letter groups and numbers without specifying the location and school name. The number of students taking Law and Justice courses in a total of five schools using AS1, BS2, CS3, DS4, and ES5 codes was determined. The "*Content and Structure of the Law and Justice Course*" sacle was applied to the students who were taking Law and Justice courses in the 6th, 7th, and 8th grades by going these schools (Table 1).

Table 1. The Number of Students Participating in the Research (2020–2021 and 2021–2022 Academic Semesters)

School Code	6th grade	7th grade	8th grade
AS1	0	0	37
BS2	0	0	83
CS3	119	41	0
DS4	79	0	0
ES5	0	87	0
Total (N: 446)	198	128	120

The aggregate number of students taking the 'Law and Justice course' from the 6th, 7th, and 8th grades in the Secondary School and Imam Hatip Secondary Schools in Sultanbeyli district in the 2020–2021 Academic Semester, and 2021–2022 Education Semester is 2853 (universe), but also the in the research 446 (sample) aggregate number of students participating. Accordingly, the universe and sample comparison of the survey application conducted for students was realized as 14.5%. Approximately 32 questionnaires were removed from the research data because of inadequate information and a random filling process.

Data Collection

The survey method was used in the collection of research data so that data are also acquired within surveys using the scaling method (Lawshe, 1975). Besides that, questionnaires are described as the sum of items that contribute to explanatory the levels of variables that can be observed indirectly with the help of several concrete expressions related to the subject and acquiring a point value related to the variable (Demirbilek, 2021; Katılmış, 2010; Yıldız, 2021). In this research, the "*Content and Structure of the Law and Justice Course*" questionnaire, which was determined as a data collection tool, was created. Accordingly, the questionnaire development stages of the questionnaire used in the research are as follows;

- The questionnaire development stages of the studies carried out using the questionnaire have been examined in detail.
- An item pool consisting of 45 judgments was created inspired by the questionnaire items used in the research of Alıcı and Van (2016), Alkayış (2019), and Aycıl and Sönmez (2018).
- The items to be included in the questionnaire were determined due to the research subject, and a candidate questionnaire/survey form was created for the questionnaire to be used.
- The prepared candidate questionnaire/survey form was presented to 10 experts.
- The new questionnaire, which was revised according to the feedback from expert opinions, was composed of 27 items.
- At the end of the process, the survey items were created and presented to 7 (seven) experts from the field of Social Studies Education and 3 (three) experts from the field of Turkish Education, and as stated by Yurdugül (2005), the content validity index of the survey was calculated to be used in this research.

Data Analysis

The judgments in the research questionnaires are divided into varied questionnaires and sub-dimensions to compose meaning and integrity among themselves and to be able to analyzed (Somer et al., 2002; Yurdugül, 2005). In this research, the judgments in the "*Content and Structure of the Law and Justice Lesson Questionnaire*" directed to the students were divided into sub-dimensions to make sense and classify them differently from each

other. In this context, to determine the level of perception and attitude of students toward the 'Law and Justice course' in the questionnaire;

- Perception Dimension of the 'Law and Justice course' and the Law
- Dimension of Attitude toward the Content of the 'Law and Justice course'
- Attitude Dimension of the Structure and Processing of the 'Law and Justice course'. The questionnaire is divided into three sub-dimensions consisting.

The data from the questionnaires were transferred to the computer manually using the SPSS 26 program thus the data were converted into numerical data. Accordingly, the created datasets were classified into sub-dimensions as previously defined, and the mean and standard deviation values of the datasets were calculated. Firstly, the statistics regarding the mean and standard deviation statistical values of the "*Content and Structure of the Law and Justice Course Questionnaire*" were arranged.

Table 2. Statistical Values of the Mean and Standard Deviation for the Content and Structure of the Law and Justice Course Questionnaire

Content and Structure of the Law and Justice Course Questionnaire	Mean	Standard Deviation	Min-Max
Perception Dimension of the Law and Justice Course and the Law	3,5181	,83451	1–5
Dimension of Attitude toward the Content of the Law and Justice Course	3,5000	,78036	1–5
Attitude Dimension of the Structure and Processing of the Law and Justice Course	3,7681	,82006	1–5

Accordingly, the average value of the attitude about the structure and teaching of the 'Law and Justice course' is 3.7681, the average value of the perception toward the 'Law and Justice course' and the law is 3.5181, the value of attitude toward the content of the 'Law and Justice course' is 3.5000. This shows that students' perceptions of the 'Law and Justice course' structure and its implementation are higher than their perceptions of the law. It also shows that their attitudes toward the content of the 'Law and Justice course' are at the lowest level (Table 2).

After the mean and standard deviation values of the data sets included in the survey were measured with the help of the SPSS 26 program, Skewness-Kurtosis values were measured to determine the normality distributions of the data (Table 3).

Table 3. Content and Structure of the Law and Justice Course Questionnaire Skewness-Kurtosis Values

Content and Structure of the Law and Justice Course Questionnaire	Skewness	Kurtosis
Perception Dimension of the Law and Justice Course and the Law	-,447	,411
Dimension of Attitude toward the Content of the Law and Justice Course	-,346	,654
Attitude Dimension of the Structure and Processing of the Law and Justice Course	-,768	1,151

As indicated in Table 5, the Skewness-Kurtosis values of all sub-dimensions were measured as minimum -768 and maximum +1.151. It was understood that the values obtained were between the normal distribution values. According to Tabachnick and Fidell (2017), Kurtosis (kurtosis) and Skewness (skewness) values should be between -1.5 and +1.5 for a normal distribution. According to this result, normally distributed data are subjected

to parametric tests (t-Test, Correlation, Multiple Regression, and ANOVA) (Erbay and Beydoğan, 2017). Therefore, ANOVA Test and t-Test were used to determine the difference and significance between the questionnaires and the variables. While 't-Test' is used in the comparison of quantitative continuous data based on two independent groups, ANOVA Test is used in the comparison of quantitative continuous data based on more than two independent groups (Kim, 2017; Köse and Öztemur, 2014). When the ANOVA test was used, the 'post hoc' method was also used to decipher, which data and variables had a significant relationship.

In the research where the data used in the survey method are obtained, the validity of the quantitative data is provided in three different dimensions: structure, scope, and appearance validity. In this research, only the Scope Validity Index (SVI) was used. According to the Scope Validity Index (SVI) stated by Yurdugul (2005), at least 5 and at most 40 expert opinions are needed to evaluate the questionnaire items in survey research. In this context, 10 expert opinions were used in the research, and the Scope Validity Index (SVI) was measured accordingly. Thanks to this method, it has been attempted to provide the subject of validity in the research.

Table 4. Sub-dimensions of Content and Structure of the Law and Justice Course Questionnaire's Validity Values

Content and Structure of the Law and Justice Course Questionnaire	Expert	SVI	KMO Barlett
Perception Dimension of the Law and Justice Course and the Law	10	0,63	0,670-0,544
Dimension of Attitude toward the Content of the Law and Justice Course	10	0,70	0,767-0,761
Attitude Dimension of the Structure and Processing of the Law and Justice Course	10	0,72	0,813-0,639

According to the scope validity index data, it shows that the SVI values of 0.63, 070, and 0.72 belonging to the three sub-dimensions of the Content and Structure of the Law and Justice Course Questionnaire provide validity. KMO values were measured for sub-dimensions of Content and Structure of the Law and Justice Course Questionnaire to be in the range of 0.813–0.544 and it was determined that this value was sufficient for validity.

The Cronbach alpha (α) coefficient is a measure of the internal consistency of the items. It is used to question or explain the homogeneity of the items in the questionnaire. Cronbach's alpha reliability test is frequently used in Likert-type questionnaires. Accordingly, Cronbach's alpha reliability values are expressed as follows;

$0< \alpha <0,40$: unreliable,

$0.40< \alpha <0.60$: low reliable interval,

$0.60< \alpha <0.80$, normal reliable interval,

$0.80< \alpha <1.00$: very high reliable interval (Kalaycı, 2008; Yıldız and Uzunsakal, 2018).

Table 5. Sub-dimensions of Content and Structure of the Law and Justice Course Questionnaire's Reliability Values

Content and Structure of the Law and Justice Course Questionnaire	İtems	Cronbach Alfa (α)
Perception Dimension of the Law and Justice Course and the Law	6	*,812*
Dimension of Attitude toward the Content of the Law and Justice Course	8	
Attitude Dimension of the Structure and Processing of the Law and Justice Course	13	

Considering the reliability analysis data of the Questionnaire on the Content and Structure of the Law and Justice Lesson in Table 5, it is seen that the Cronbach alpha value is “,812.” Accordingly, the reliability of the questionnaire is in the very high-reliability range.

Research Ethics

“After preparing the necessary documents concerning the research and ethics committee approval necessary documents, the research process and publication process, the research measurement tools, research data, and all processes were submitted to the xxxxxxxxxxx Institute of Educational Sciences Research Ethics Committee”.

FINDINGS

The general descriptive information of the students who took the ‘Law and Justice course’ who participated in the survey application in the research is shown in Table 6.

Table 6. Distribution of the Descriptive Characteristics of the Participants

Descriptive Information		*f*	%
Sex	Female	210	50,7
	Male	204	49,3
Total		414	100
School	Secondary School	263	63,5
	Imam Hatip Secondary School	151	36,5
Total		414	100
Classroom	6th grade	189	45,7
	7th grade	116	28,0
	8th grade	109	26,3
Total		414	100
Family Monthly Income*	1500–2000 ₺	154	37,2
	2001–3000 ₺	132	31,9
	3001–4000 ₺	67	16,2
	+4001 ₺	61	14,7
Total		414	100

*The minimum wage of Turkey for 2021 is based on 2825 ₺ per month.

While looking at descriptive information 50.7% of the participants in the study are male and 49.3% are female. A close balance has been established between these data and the participants of the study in terms of gender. In terms of the school, 63.5% of the participants are Secondary School students and 36.5% are Imam Hatip Secondary School students. According to the class distribution, 45.7% of the participants are 6th-grade students, 28% are 7th-grade students and 26.3% are 8th-grade students. According to the monthly income status of the

family, 37.2% of the participants stated that they had a monthly income of 1500–2000 ₺, 31.9% of 2001–3000 ₺, 16.2% of 3001–4000 ₺, 14.7% of +4001 ₺ and above.

The averages of the Content and Structure of the Law and Justice Course Questionnaire according to the family income level of the students participating in the research and the results of the ANOVA Test were classified within the scope of the research questions.

Findings 1

Student families' monthly income-level and their perception of the Law and Justice course and law

Table 7. Means of Perceptions of Law and Justice Course and Law by Family Income level and ANOVA Test

Independent Variable	Family Monthly Income**	N	Mean	Std.	Min	Max	F	p*
Perceptions of Law and Justice Course and Law	1500–2000 ₺	154	3,3626	,64652	1,67	5,00	,952	,416
	2001–3001 ₺	132	3,3081	,59596	1,33	5,00		
	3001–4000 ₺	67	3,2861	,58373	1,67	4,33		
	+4001 ₺	61	3,2104	,58603	1,50	4,50		

*p≤0,05 **The minimum wage of Turkey for 2021 is based on 2825 ₺ per month.

As seen in Table 7, it is understood that: for law and justice and law students, the perception of the means of family income shows a significant difference according to the variable to determine whether performed ANOVA test because of the difference between the monthly income of the family (F: 952/p,416), statistical aspects are not significant. According to the family income levels of the students, the highest perception score for the 'Law and Justice course' and the law was 1500–2000 ₺ (Avg.: 3, 3626) while the income level was the lowest, the perception scores for the 'Law and Justice course' and law were +4001 ₺ (Mean: 3, 2104) income-level.

Findings 2

Attitudes of students' families regarding the monthly income-level variable and the content of the 'Law and Justice course'

Table 8. Means of Perception of the Content of the Law and Justice Course According to Family Income-Level and ANOVA Test

Independent Variable	Family Monthly Income **	N	Mean	Std.	Min	Max	F	p*
Perception of the Content of the Law and Justice Course	1500–2000 ₺	154	3,2938	,64002	1,00	4,75	4,171	,006
	2001–3001 ₺	132	3,4659	,54870	2,13	5,00		
	3001–4000 ₺	67	3,4813	,57169	1,88	5,00		
	+4001 ₺	61	3,5697	,55973	1,75	4,88		

*p≤0,05 **The minimum wage of Turkey for 2021 is based on 2825 ₺ per month.

As seen in Table 8, it is understood that: because of law and justice in the attitude of students regarding the content of the course, the means of family income shows a significant difference according to the variable to determine whether performed ANOVA test because of the difference between grade levels (F: 4,171/p: 006), has been determined to be statistically significant aspects. A post hoc test was also conducted to determine the sources of these differences, and because of the test, it was found that there was a significant difference in attitude toward the content of the 'Law and Justice course' between students with family income levels between 1500 ₺ and 2000 ₺ and +4001 ₺ income.

Findings 3

The attitude of student families about the monthly income-level variable and the structure and processing of the Law and Justice course

Table 9. Means of Attitudes About the Structure and Administration of Law and Justice Course by Family Income level and ANOVA Test

Independent Variable	Family Monthly Income **	N	Mean	Std.	Min	Max	F	p*
The Structure and Administration of Law and Justice Course	1500–2000 ₺	154	3,4411	,58139	1,38	5,00	1,745	,157
	2001–3001 ₺	132	3,5402	,50567	1,85	5,00		
	3001–4000 ₺	67	3,5017	,50767	2,00	5,00		
	+4001 ₺	61	3,6217	,63871	1,77	5,69		

*p≤0,05 **The minimum wage of Turkey for 2021 is based on 2825 ₺ per month.

As seen in Table 9, it is understood that: the means of family income in attitudes about the course structure, students, and teaching the law and Justice show a significant difference according to the variable to determine whether performed ANOVA test because of the difference between grade levels (F: 1,745/p,157), statistical aspects are not significant. According to the family income-levels of the students, the attitude score about the structure and processing of the 'Law and Justice course' is the highest +4001 ₺ (Mean: 3, 6217), while the income level, the lowest perception score for the 'Law and Justice course' and law is the income level of 1500–2000 ₺ (Mean: 3, 4411) (Table 9).

DISCUSSION AND CONCLUSION

This research examines the perceptions and attitudes of students toward the 'Law and Justice course', which is given as an elective course in secondary schools, according to the family income level, and to decipher the relationship between them. In this context, the perception of the 'Law and Justice course' and the law, the attitude to the content of the 'Law and Justice course', and the attitude sub-dimensions about the structure and processing of the 'Law and Justice course' are evaluated according to the family monthly income variable;

- The difference between the student's perceptions of the 'Law and Justice course' and the law and the family monthly income-level variables were not found significant.
- The difference between the student's attitudes toward the content of the 'Law and Justice course' and their family monthly income level was found to be significant. According to the post hoc test, it was understood that there was a significant difference between the students whose family income variables were between 1500 and 2000 ₺ and +4001 ₺ in terms of attitudes toward the content of the 'Law and Justice course'.
- It was determined that there was no significant difference between the students' attitudes about the structure and teaching of the 'Law and Justice course' and the variables of family income level.
- Students' perceptions of the 'Law and Justice course' and law according to their family income levels are the highest at 1500–2000 ₺ income level, while their perceptions toward the 'Law and Justice course' and law are the lowest at +4001 ₺ income level. According to the family income levels of the students, the highest attitudes about the structure and processing of the 'Law and Justice course' are +4001 ₺ income level, while the lowest attitudes about the structure and processing of the 'Law and Justice course' are 1500–2000 ₺ income level.

In this context, when previous studies are examined, Alkayış (2019) and Aycıl (2017) stated that as the monthly income level of student families increases, the level of differentiation in their perceptions and attitudes toward the 'Law and Justice course' increases. Aycıl and Sönmez (2018) also stated that there is a significant relationship between the monthly income level of student families and their perceptions and attitudes toward the 'Law and Justice course'. When the studies conducted outside the 'Law and Justice course' are examined; Benenson et al. (2007) stated that children's behavioral development interacts with their socioeconomic development level; Balbağ et al., (2019) also discussed the family income situation in terms of the individual's ability to supply products and stated that there is a positive relationship between students' family income and their use of technology products, and as the frequency of use of technology products increases, students' justice tendencies differ and decrease.

This research was conducted in Sultanbeyli district (Şahinoğlu, 2020), one of the poorest districts in terms of household income in Istanbul in terms of purpose and accessibility. For this reason, the results obtained should

be evaluated in terms of the administrative position where the research was applied. In this context, as Başoğlu (2017), Baum, and O'Malley (2003) and Tunç (2020) stated, the economic status of families also affects students' understanding of justice as their perceptions, attitudes, and behavior toward education given in the classroom. When the results of the research are examined, the difference between the student's attitudes toward the content of the 'Law and Justice course' and their family's monthly income level is significant, which supports this situation.

Implications

The fact that the students' attitudes toward the structure and teaching of the 'Law and Justice course' are higher than their perceptions of the 'Law and Justice course' and the law indicates that the student's legal perceptions are not sufficiently formed even though the subjects related to law are covered in the course. To overcome this situation, it would be useful to take students to places such as courthouses, police stations, and law offices where legal issues are handled concretely (Alıcı and Van, 2016; Alkayış, 2019).

The significant difference between the student attitudes toward the content of the 'Law and Justice course' and the family monthly income level revealed that the expectations and achievements of the students regarding the content of the course were different. Aycıl and Sönmez (2018) also stated in their research that teachers should make the students active in the course while teaching the 'Law and Justice course' and that the different socio-economic status of the students should be homogenized during the course.

Limitations

Although the fact that the administrative place chosen in the research is the Sultanbeyli district in Istanbul province has formed a segment close to the desired target group in terms of household income, it is insufficient to provide a generalizing result of the research (Yalçın, 2008). Indeed, conducting similar studies in administrative places with low household incomes may be useful in terms of comparing students' perceptions and attitudes toward the 'Law and Justice course' and law. However, it will be useful to compare the research conducted in high-income places in terms of household income with the research conducted.

In this study, a descriptive relational research model used. Because the participants consist of different grade levels and different individuals, the results obtained should be evaluated within this limitation. In future research, longitudinal research design can be used to examine the change in perceptions and attitudes of the same individuals toward the 'Law and Justice course' and law when they move to different-grade levels.

Statements of Publication Ethics

Participants were informed about the data collection and analysis process before participating in this study. Additionally, they signed the consent forms indicating that they agreed to participate in the study. The collected data and the information of the participants are kept confidential. An ethical approval certificate was given from Marmara University Educational Sciences Ethics. Ethics committee document number is 137028/7-18.

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APPENDIX A.

HUKUK VE ADALET DERS İÇERİĞİ VE YAPISI ANKETİ

Sıra No	Bu bölümde bulunan ifadeler sizin hukuk konularına karşı tutumunuzla ilgili düşüncelerinizi öğrenmek için hazırlanmıştır. Sizlerden istenen maddeleri dikkatlice okumanız ve kendinize en uygun olan seçeneği "X" işareti koyarak işaretlemenizdir. Her cümle için yalnızca bir seçeneği işaretleyiniz.	Hiç katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Tamamen Katılıyorum
	Hukuk ve Adalet Dersine ve Hukuka Yönelik Algı					
1.	Hukuk ve Adalet dersini beğenmekteyim.					
2.	Hukuk ve Adalet dersine severek çalışır ve hazırlanırım.					
3.	Hukuk ve Adalet dersini seçmem iyi oldu diyebilirim.					
4.	Derse olan ilgi ve merakım dersin öğretim sürecinde maksimum düzeydedir.					
5.	Hukukla ilgili (hâkim, savcı, avukat) meslekleri hiç sevmem.					
6.	Hukuk konuları ile ilgili bir şeyler okumak ilgimi çekmez.					
	Hukuk ve Adalet Dersinin İçeriğine İlişkin Tutum					
1.	Hukuk ve adalet konuları ile ilgili Sosyal Bilgiler dersi tek başına yeterlidir.					
2.	Hukuk ve Adalet dersindeki konuların içeriği güncel olaylardan ve günlük yaşamdan olaylardan seçilmiştir.					
3.	Hukuk ve Adalet dersinin içeriği yeterlidir.					
4.	Konular, adil olma değeri ve farkındalık kazandırılmasında etkili olabilecek niteliktedir.					
5.	Hukuk ve Adalet dersinde verilmesi gerekenden çok fazla bilgi verilmektedir.					
6.	Dersin içeriğindeki konular toplumun ihtiyaçlarına hizmet edecek niteliktedir.					
7.	Dersin içeriği kazanım elde etmemiz için uygun ve yeterlidir.					
8.	Hukuk ve Adalet Dersi içeriği öğrencilerin günlük hayatlarında kullanabileceği bilgileri içermektedir.					
	Hukuk ve Adalet Dersinin Yapısı ve İşlenişi Hakkında Tutum					
1.	Ders kitabındaki veya e-kitaptaki görseller konuları anlamama yardımcı oluyor.					

2.	Hukuk ve Adalet dersinde adliyeye gezi düzenlenmelidir.					
3.	Hukuk ve Adalet dersinde anlamını bilmediğim çok kelime bulunmaktadır.					
4.	Hukuk ve Adalet dersi için iki saatlik ders saati süresi yeterlidir.					
5.	6. 7. ve 8. sınıflar için Hukuk ve Adalet dersi uygundur.					
6.	Hukuk ve Adalet ders kitabı ya da e-kitabı görsel ve tasarım yönünden dikkat çekici buluyorum.					
7.	Ders kitabındaki ya da e-kitaptaki bilgiler açık, sade ve anlaşılır bir dille yazılmıştır.					
8.	Ders kitabında veya e-kitapta yer alan konular açık ve anlaşılırdır.					
9	Hukuk ve Adalet dersi yapısal olarak özsaygı ve hak arayışları konularına değinmektedir.					
10.	Hukuk ve Adalet dersindeki etkinlikler sıkıcı değildir.					
11.	Bu ders Hukuk ve Adalet kurumlarının nasıl işlediğini bizlere öğretmektedir.					
12.	Hukuk ve Adalet dersinde uygulanan program farklı öğretim yöntem ve tekniklerini kullanmaya yönelik olanak sunmaktadır.					
13.	Öğretmen kılavuz kitabı olmaması öğretmenler açısından bir problemdir.					

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Determination of Academics' Mental Models About Science, Scientists, and Perceptions of Scientific Development

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Abstract

Purpose: This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development.

Method: The survey method was used in the research. The participants of the study are a total of 112 academics with different academic titles working in universities in seven different regions of Turkey, which include the faculties of health sciences, social sciences, natural sciences, and educational sciences. The study used an interview form consisting of 6 questions developed by the researchers as a data collection tool. The data obtained from the corresponding form were transcribed and analyzed in NVivo 9.0.

Results and Conclusion: When the data obtained from the participants are evaluated; (i) academics frequently use the definitions in scientific books when defining the concept of science, (ii) there is an effect of the department variable and popular events studied in their thoughts on the concept of scientist, (iii) there are differences in their perceptions of the development of science between the areas where development is expected worldwide and the areas where change is expected in Turkey. Depending on the results obtained, implications were presented to academics and researchers who want to conduct research in the subject area.

Keywords: Academics, mental model, science, scientist, scientific development

Akademisyenlerin Bilim, Bilim İnsanı ve Bilimsel Gelişim Algılarına İlişkin Zihinsel Modellerinin Belirlenmesi

Öz

Amaç: Bu araştırmada akademisyenlerin bilime, bilim insanlarına ve bilimsel gelişme algısına ilişkin zihinsel modellerini belirlemeyi amaçlamıştır.

Yöntem: Araştırmada tarama yöntemi kullanılmıştır. Araştırmanın katılımcılarını Türkiye'nin yedi farklı bölgesindeki sağlık bilimleri, sosyal bilimler, fen bilimleri ve eğitim bilimleri fakültelerinde görev yapan farklı akademik unvanlara sahip toplam 112 akademisyen oluşturmaktadır. Araştırmada veri toplama aracı olarak araştırmacılar tarafından geliştirilen 6 sorudan oluşan görüşme formu kullanılmıştır. İlgili formdan elde edilen veriler, NVivo 9.0 programına aktarılmış ve analiz edilmiştir.

Bulgular ve Sonuç: Katılımcılardan elde edilen veriler değerlendirildiğinde; (i) akademisyenlerin bilim kavramını tanımlarken bilimsel kitaplardaki tanımları sıklıkla kullandıkları, (ii) bilim insanı kavramına yönelik düşüncelerinde görev yaptıkları bölüm değişkeni ile popüler olayların etkisinin olduğu ve (iii) Bilimin gelişimine yönelik Dünya çapında gelişme beklenen alanlar ile Türkiye'de gelişme beklenen alanlar arasında farklılıkların olduğu ortaya konulmuştur. Elde edilen sonuçlara bağlı olarak konu alanında araştırma yapmak isteyen akademisyen ve araştırmacılara öneriler sunulmuştur.

Anahtar Sözcükler: Akademisyen, zihinsel model, bilim, bilim insanı, bilimsel gelişim

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INTRODUCTION

The duration of a science term is the time it takes to find solutions to problems that arise in everyday life. It is rising the products that obtain favor for humans at the end of this period (Flick & Lederman, 2006). Though science is stated in general, it is difficult to define conceptually and procedurally because it is used in so many sectors such as engineering, health, and education. In this complex case, many views, such as creating knowledge, respecting scientific information, building on epistemological footing, and scientists' perceptions, are used to define science (McComas, 2002). Albert Einstein's science is characterized as enabling compatibility efforts between various sensory facts devoid of many orders and proper thoughts (Holton, Galison, & Schweber, 2008). Otherwise, Bertrand Russell defines science as an attempt to discover the law by observation and observational reasoning (Russell, 1998). According to the Turkish Language Society (2018), science is a term that refers to interrogating the cosmos or occurrences as part of a systematic research process aimed at reaching a result using methods and reality based on scientific experimentation. When the definitions are considered, science has a framework that can arise and evolve with thoughts, observations, and experiments. Ultimately, science is a phenomenon that originates from people's curiosity, assists them in improving their living situations, discovers unknowns, and is continually evolving (Matthews, 2012).

The concept of science has significant implications for human life, raising people's living standards by instilling a feeling of curiosity in them (McComas, 2002). Therefore, some people have been drawn to this profession and have begun to work in it. As a result of these advances, the term "scientist" was coined. Scientists are those who understand how to get information by utilizing the science and its products to obtain the most correct information, analyze that information, keep up with new scientific advancements, and apply science in their daily lives (Kara, 2013). It has become necessary to work on the topic area due to the scientific, economic, and social values of the concept of science and scientist. For this reason, it is necessary to define the mental models of people for the concept of science and scientist (Engineering and Public Policy Committee on Science, 2009).

What does it mean to have a scientific image?

The physical, mental, and characteristic portrayal that comes to his/her eyes when he/she imagines a scientist can be defined as the impression that the individual develops in his/her mind about the scientist. Individuals must have experienced specific preliminary experiences relating to the image of a scientist to design one in their imaginations. These encounters can take the form of seeing a scientist's picture, reading a book's depiction of a scientist, watching a re-enactment or video about a scientist, meeting a scientist, or hearing others' accounts of a scientist. From this perspective, various external conditions have an impact on the images of scientists generated in individuals (Engineering and Public Policy Committee on Science, 2009). Schibeci, Webb, Robinson, and Thorn (1986) express that media and television play a significant part in the stereotyping of images made for scientists in their study. Yontar-Togrol (2000) claims that the media's influence on the stereotyping of scientist pictures is undeniable. Many scientists have attempted to determine the image of pupils toward scientists, including Chambers (1983), and Mead and Metraux (1957). First studies on the determination of images for science and scientist, Mead and Metraux found positive and negative aspects of scientists' images in their renowned experiment with high school students in the United States.

Positive Images

1. The scientists are genius and put in a lot of effort for science.

2. The scientists are cautious, hardworking, patient, fearless, and open-minded. Moreover, they are universally minded, comprehensive, morally copyrighted, and enlightened people.

3.Even if scientists fail in their studies, they never give up. They continue to carry out their work.

4.The scientists work for the good of their nation, not for the sake of money or fame.

5.The scientists are genuinely remarkable individuals, and the future rests on their shoulders.

6. Scientists follow new developments in science and technology and can use technology in their daily life.

Negative Images

1. When conducting research, scientists think a lot about everything, but it's not significant thinking and the scientific topic in which scientists works is uninteresting, tedious, and boring.

2. The scientists are on their own if they do their work alone, and the financial weight of their research is significant.

3. Scientific study has the potential to be hazardous. The chemicals it works with might explode or be harmed by radiation exposure.

4. Scientists have become so engrossed in their job that they are completely unaware of what is going on around them.

5. It has the potential to compel your children to choose careers as scientists.

6. Most scientists aren't married because no one wants to marry someone like that.

Concordantly when the literature is examined, the images of studies about the opinions and thoughts of kindergarten students (Can, Yildiz-Demirtas, & Altun, 2017; Eckhoff, 2017; Lee, 2010; Ozel, 2012), primary school students (Agranovich & Assaraf, 2013; Cermik & Fenli-Aktan, 2020; Emvalotis & Koutsianou, 2017; Fung, 2002; Monhardt, 2003), middle school students (Fung, 2002; Gibson & Chase, 2002; Koren & Bar, 2009; Medina-Jerez, Middleton, & Orihuela-Rabaza, 2011; Ruiz-Mallén & Escalas, 2012; Scherz & Oren, 2006; Yvonne, 2002), high school students (Bennett & Hogarth, 2009; Scherz & Oren, 2006; Singh, 2015; Taylor et all., 2022), university students (Chittleborough, Treagust, Mamiala, & Mocerino, 2005; Miele, 2014; Provost et all., 2011; Rizk, Jaber, Halwany, & BouJaoude, 2012) about science and scientists were found. When looking at studies on this topic, however, there is not enough work on academics' opinions and perceptions on the subject. Whereas the views and opinions of academics in universities, expressed as a field of competence in the production and use of science, are extremely important. In this regard, the goal was to find out what university academics thought about mental models of science and scientists, as well as the progress of science. For the related purpose, the main questions of "*What are the mental models of academics about science and scientists*?" and "*What are the perceptions of academics about the development of science?*" have been emphasized. Accordingly, academics' opinions about the concept of science, the occurrence process, the product revealed by science, the scientific concept, the development of science in the world, and the development of science in Turkey, have been examined.

The Aim of the Study

This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development.

Research Questions

The main problem situation of this research is *"What are the academicians' thoughts on science, scientists, and scientific development?".* Depending on this main problem situation, the sub-problem situations are as follows:

1. "How do you define the concept of science?" and "What do you think about the concept of science?"
2. "How do you think science emerged?" and "What are the factors affecting the emergence of science?"
3. "What are your thoughts about the products that science has created?" and "Can you illustrate your thoughts about scientific products?"
4. "Who is called the scientist and what kind of features does it have?" and "When you are called a scientist, who is the first person to come to your mind and why does this person come to your mind?"
5. "In which fields, science is developing worldwide?"
6. "In which fields, science is developing in our country?"

METHOD

Research Design

This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development. For this purpose, the survey method as a qualitative approach has been preferred. The survey method can be explained as studies in which qualities such as opinions-interests-skills-attitudes of individuals on any subject are investigated by describing them by measuring them with a single application. If the

purpose of research is to make a description by taking a picture of the current situation related to the research subject, the most appropriate research method is the survey method (Grovers et all., 2011).

Participants of the Study

The participants of the research were from Turkey's seven regions (Marmara, Black Sea, Aegean, Central Anatolia, Mediterranean, Eastern, and South-eastern Anatolia), and have been selected among the academics performing their studies as academics in four different fields of health sciences, social sciences, natural sciences, and education sciences. It consists of a total of 112 personnel, 1 from the academic level/title and 16 from each university. In the selection of such universities and academics; the simple random sample selection technique was preferred considering the applicability of the research, it executes ability and the representation of the universe. Simple random sample selection is a method in which everyone has the same chance of being chosen and thus increases the probability of representing the universe (Creswell & Cresswell, 2017). By the ethical rules, the participants have been coded as A1, A2, …, and A112. Qualitative information about the participants is presented in Figure 1.

Figure 1. The Qualitative Information about the Participants

Marmara	Black Sea	Aegean	Central Anatolia
Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.

East Anatolia	Mediterranean	Southeastern Anatolia	TOTAL
Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Health Sciences (28)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Social Sciences (28)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Natural Sciences (28)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (4)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	**Educational Sciences (28)** Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.

Data Collection Tool

The study was carried out 6-question interview form developed by the researchers has been used in the study. While the questions have been composed, it has been attentive to representing the purpose of the research and the problem situations and it has taken the advantage of experts and field writing.

The data collection process of the research was carried out with an interview form consisting of 6 questions created by the researchers. The interview form was transferred to the online platform via "Google Form" and the participants were asked to fill in the form consisting of 6 questions. By the ethical rules in the research, only the academic titles and regional variables were requested from the demographic information of the participants. It was also stated that they would be coded and included in the scope of the research by law on the protection of personal data. After analyzing the data obtained from the participants, findings for the research were created.

Data Analysis

The data obtained from the structured interviews with the participants of the study were analyzed using the NVivo 9 Program. The presence of the codes in the qualitative data was determined by the data gotten by the transcription, obtained with the help of the voice recorder. The content analysis process in which the themes were created, and the inferences were made was performed by putting these codes together (Seers, 2012; Thorne, 2000).

Credibility and Consistency

For the credibility factor, the long-term interactions, the confirmations of participants, and the opinions of experts are the most common applications. In long-term interaction, remaining the researchers in the search area as much as possible ensures the elimination of prejudices and the recognition of the culture of the research environment (Jha, 2008). To solve such problems, the study can be carried on by the confirmation of participants. Within the scope of the research, long-term interaction and participant confirmation criteria have been taken into consideration. In the studies, for the consistency factor, the compatibility factor of the analysis made by the different researchers and if the applications are repeated or not repeated are taken into consideration (Lincoln & Guba, 1985). Within the scope of the research, academics' answers to interview questions for the theme of consistency have been classified separately by the researchers. By the comparison of these categories, it was tried to be consistent with the compatibility between independent observers.

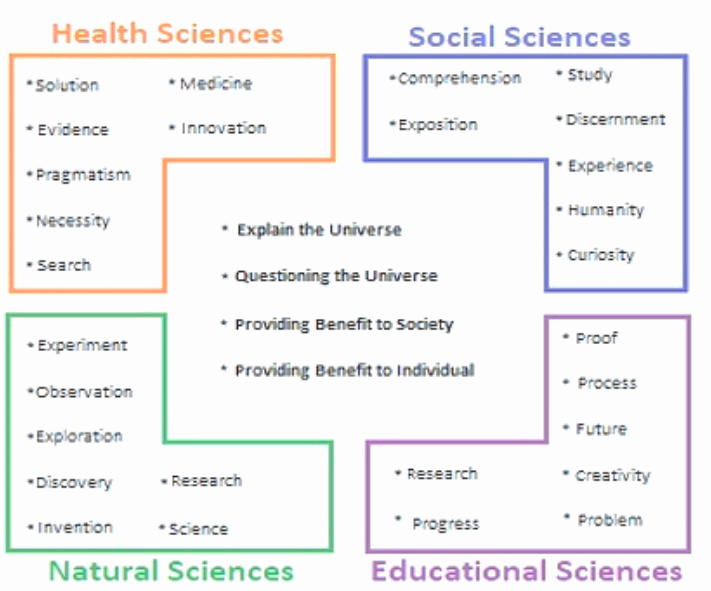
Research Ethics

To carry out the data collection process in the research, the Social and Human Sciences Scientific Research and Publication Ethics Committee of the university was applied, and the necessary approvals were obtained. In addition, by the ethical rules in the research, the participants were expressed with codes.

FINDINGS

According to the subject of the research, the findings obtained from the answers of the participants in the structured interviews were divided into six themes as the sub-problems of the study. As the first theme of the study, the questions "*How do you define the concept of science?*" and "*What do you think about the concept of science?*" are asked of academics about the concept of science. The data obtained from the participants are presented in Figure 2.

Figure 2. The Views of Academics about the Concept of Science



When examining Figure 2, it is seen that there are similarities and differences between the views of academics in preferred participant groups regarding the 'science' term. The common characteristics of the participant groups regarding the concept of science are seen being combined with their efforts to explain and question the universe and to benefit the individual and society.

• A44 coded participant verbalizes his/her opinion that science is an attempt to **explain and question the universe**, as *"Science is a concept that explains the reasons for the events occurring in the universe, bases these reasons on scientific facts, and emerges products"* and A21 coded participant verbalizes it as "*Science is the observations and experiments that people have in an attempt to understand the nature and to investigate the causes of occurrence of the events*".

• A12 coded participant saying science is based on **providing benefit to society and the individual** has been explained that "*Science provides benefits to individuals and then to the societies that individuals come together with*". A03 coded participant described as "*Science has emerged in line with individual or social needs and the solutions put for this concept, directly affect the needers*".

Differences between science concepts, in terms of participating groups as health scientists, have been found as 'evidence, necessity, and innovation'. For the variables of evidence, necessity, and innovation in the data obtained from health scientists, A07 coded participants' opinions that science is the structure that has been revealed in the subjects they need.

• A07 coded participant stated his opinion about '**evidence, necessity and innovation**' variables in data obtained from health scientists have defined as "*Science is the structures that have been revealed in the subjects that people need. The evidence factor plays an important role in the adoption of these structures as science*".

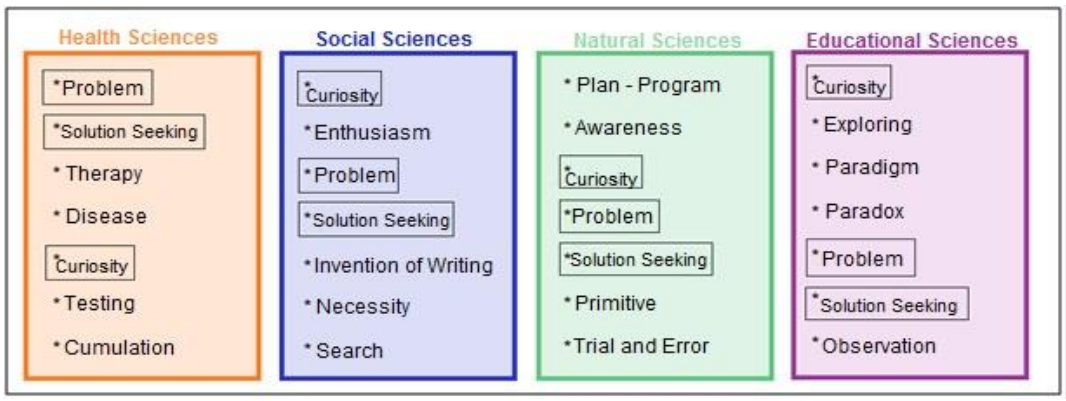
• For social scientists, differences in science are found as 'experience, comprehension, and curiosity. In the data obtained from social scientists, according to variables such as '**experience, comprehension and curiosity**', A14 coded participant described his/her opinion as "*Science is evaluated within the 'reasoning and research cycle. This concept is the process of conducting the process by individuals' competencies or researches when they are not enough with their experiences"*.

• According to the perspective of natural scientists, science-related differences are found as 'experiment, observation, and invention'. For variables in the data obtained from scientists reported as '**experiment, observation, and invention**', A23 coded participant described his/her opinion as "*Science is the name given to the information obtained because of examination using experiments and observations in nature, with the idea of providing social benefit"*.

• According to the obtained data, science finds its place in circulation such as through discovery and invention.' From the point of view of educational scientists, the differences related to a science show variations such as 'proof, process, and problem'. For variables in the data obtained from educational scientists that were reported as '**proof, process and problem**', A31 coded participant verbalized his/her opinion as "*It is the whole of the methods that individuals have chosen in the process to find solutions to the problems they face in daily life*".

As the second theme of the research, the questions "How do you think science emerged?" and "What are the factors affecting the emergence of science?" are asked of academics about the **emergence of science**. The data obtained from the participants are presented in Figure 3.

Figure 3. The Views of Academics about the Emergence of Science



As stated in Figure 3, it is seen that the opinions of academics about the emergence of science are gathered under two headings as identical and different codes between health sciences, social sciences, natural sciences, and educational sciences. The identical codes of the participant groups for the emergence of science are "**problem, solution seeking, and curiosity**". Different codes for the emergence of the science indicated by social scientists are found as the invention of writing and necessity.

- In the field of social sciences, the A57 coded participant, who works as an academic, expressed his/ her opinion on the emergence of science as "*In terms of science, the discovery of writing has been very important. People were able to understand science, do research, and demonstrate similarities and differences between their requirements and the needs of other societies*".

Different codes for the emergence of the science mentioned by health scientists are "disease and testing".

- In the field of health sciences, the A35 coded participant, who works as an academic, described his/ her opinion on the emergence of science as "*There are two important mottoes in the emergence of science. First, people seek solutions to the diseases or problems they have encountered. The second is their desire to learn about the subjects they are curious about. Solving the problem by carrying on studies and accumulation of tests by performing tests is the basis of science*".

Different codes for the emergence of the science mentioned by natural scientists are '**primitive and trial & error**'.

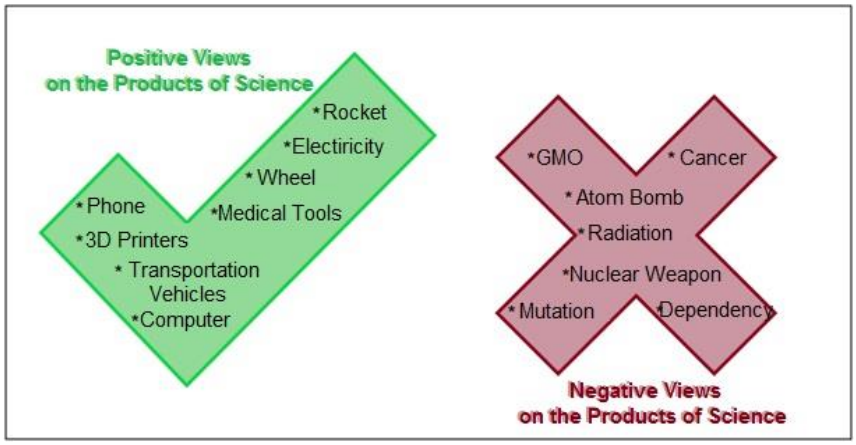
- In the field of natural sciences, the A49 coded participant, who works as an academic, described his/ her opinion on the emergence of science as "*Science has come to the present day from primitive men, whom we call humanity's beginning. Primitive man wondered about the environment, nature, objects, and sky. These feelings of curiosity have caused them to encounter various problems or insufficiencies*".

Different codes for the emergence of the science described by educational scientists are '**paradox and paradigm**'.

- In the field of educational sciences, the A63 coded participant, who works as an academic, mentioned his/ her opinion on the emergence of science as "*Science is the process of solving the problems within the frame of human beings' efforts to make sense of the environment depending on the curiosity. In this process, the contribution of the paradoxes, which are called a set of ideas that cannot be solved within them, is very important with the influence of the paradigms that dominate in a certain period*".

The third theme of the research asked the academics about the products produced by science "What are your thoughts about the products that science has created?" and "Can you illustrate your thoughts about scientific products?". The data obtained from the participants are presented in Figure 4.

Figure 4. The Views of Academics about the Products of Science



As outlined in Figure 4, it is seen that the opinions of academics about the products produced by science are divided into two headings positive and negative. Positive views on the products of science, phone, 3D printers, vehicles, computers, medical tools, wheels, electricity, and rocket are shown with examples under eight sub-

headings. Negative views on the products of science are expressed under seven sub-headings as GMO (Genetically Modified Organism), the atomic bomb, radiation, nuclear weapon, mutation, dependency, and cancer.

- A11 coded participant described his/her opinion as positively, the products of science as **phones, 3D printers, and computers**, mentioned that "*Science started with the phone, for me. It's a dream to be on the other side of the line by dialing the keys and being able to talk through the connections, isn't it? The emergence of the computers where we moved our communication activities to the summit should have been an event that stepped into a new age. No longer then, functions that you can perform via the computer can also perform via the phone. While I was thinking 'Let's see what will come out soon, I came across this time, with 3D printers*".

As positively,

- A52 coded participant described his/her opinion, the products of science as '**the wheel, vehicles, and rocket**', mentioned that "*The wheel is the most important invention. Considering the conditions of the period, the formation of a smooth rolling structure, then transporting it to the vehicles, was important. There is a kinship between the first wheel silhouettes and those preferred today. This development has influenced many means of transportation, from car to train, from train to aircraft, and perhaps even as a starting point for rockets*".

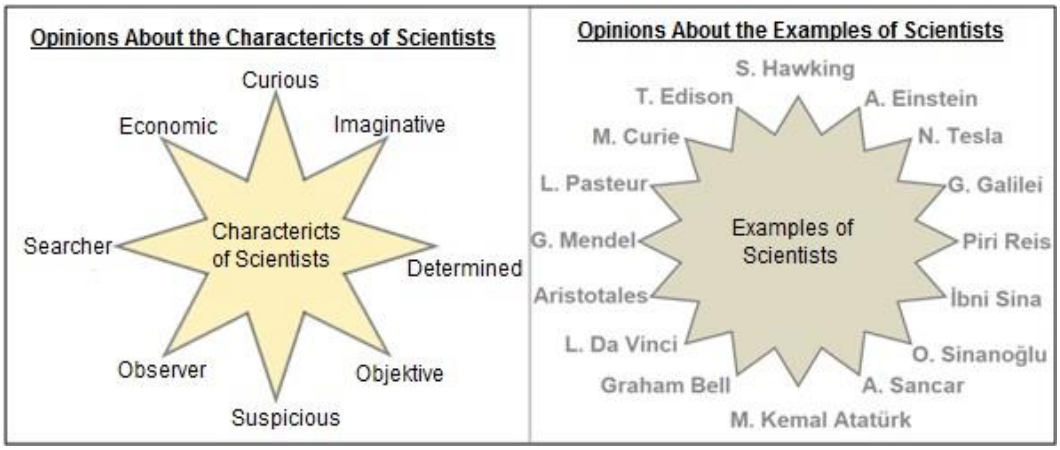
- A29 coded participant described his/her opinion as positive, the products of science as '**medical tools and electricity**' and mentioned that "*Ultrasound devices, positron emission tomography instruments, and anesthesia equipment are important structures for the prevention and treatment of diseases. Considering the change and development of these structures from past to present, it is possible to see positive developments*". As negatively,

- A42 coded participant described his/her opinion, the products of science as '**atom bomb, nuclear weapon, radiation, and cancer**', mentioned that "*Although the importance of science and its benefits for the people are mentioned, the atomic bombs sent to Hiroshima and Nagasaki, the radiation emitted by technological devices and instruments, and consequently the increase in cancer rate worldwide, are the topics that need to be considered and emphasized*".

- A39 coded participant described his/her opinion as negatively, the products of science as **GMO, mutation, and dependency,** mentioned that "*The fact that genetically modified nutrients entered our cabinets led to the incidence of mutated births. Missing-toed babies, conjoined twins, children without any limbs, and more … The news of the deaths of young people, who are addicted to technology because of the games they play or their desire to become popular, will be sufficient to explain the negative aspect of science*".

The fourth theme of the research was asked the academics about 'the scientist term' as "Who is called the scientist and what kind of features does it have?" and "When you are called a scientist, who is the first person to come to your mind and why does this person come to your mind?". The data obtained from the participants are presented in Figure 5.

Figure 5. The Views of Academics about the Concept of Scientists



As illustrated in Figure 5, the views of academics on the concept of scientists are gathered under two different headings: the characteristics of the scientist and the scientists. Participants expressed the characteristics they possessed in fewer than eight sub-headings: 'curious, imaginative, determined, objectivity, suspicious, observer, searcher, and being economic'. The sample models of the participants for the concept of the scientist are S. Hawking, A. Einstein, N. Tesla, G. Galilei, Piri Reis, Ibn Sina, O. Sinanoglu, A. Sancar, M. Kemal Ataturk, Graham Bell, L. Da Vinci, Aristotle, G. Mendel, L. Pasteur, M. Curie, and T. Edison, are described under 16 headings.

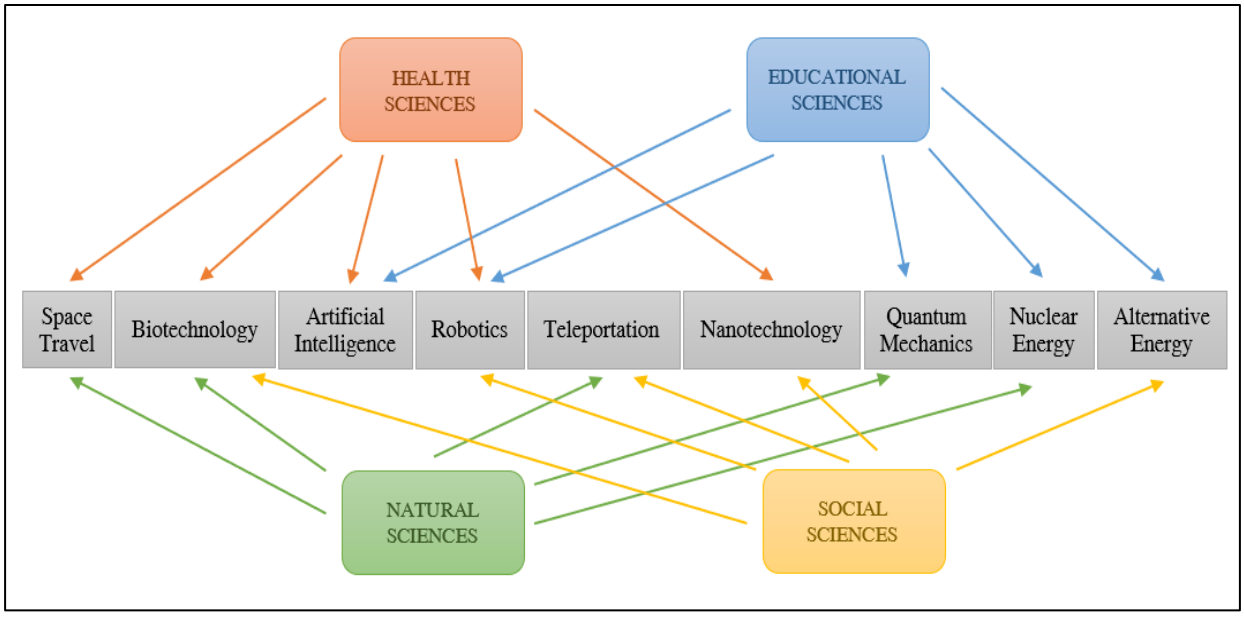
- Participant A09 who mentioned the **'curious, determined, suspicious and observer'** factors for the characteristics of the scientists, described his/her opinion as: "*People who work with science if they are kneaded by the philosophy of the work, underneath, 'curiosity against the environment and nature, the causes and consequences of the events in the environment and nature, taking into account the question of inquiry and reversibility, taking into account is based on the approach by suspicion*".

- A54 coded participant, referring to the factors, '**observer, determined and objective**' for the characteristics of the scientists, expressed his/her opinion as: "*Scientists should be good observers. However, observation alone will not be sufficient. It is necessary to be persevered to start and finish the research, regardless of what reason, not to leave the job, and to look at the events objectively, even if it contradicts their thoughts*".

- A61 coded participant, referring to the **'imaginative and economic'** factors for the characteristics of the scientists, stated his/her opinion as, "*Scientists are imaginative. They can use their imagination to look at events from different perspectives and see things that nobody has ever seen before. This situation causes us to gain an advantage in time and cost*".

The fifth theme of the research was asked the academics about 'the development of science on earth' as, "In which fields, science is developing worldwide?". The data obtained from the participants are presented in Figure 6.

Figure 6. *The Views of Academics about the Development of Science in the World*



As Figure 6 demonstrates, the views of academics on the development of science in the world are gathered under nine different headings: quantum mechanics, nuclear energy, teleportation, biotechnology, robotics, alternative energy, nanotechnology, artificial intelligence, and space travel.

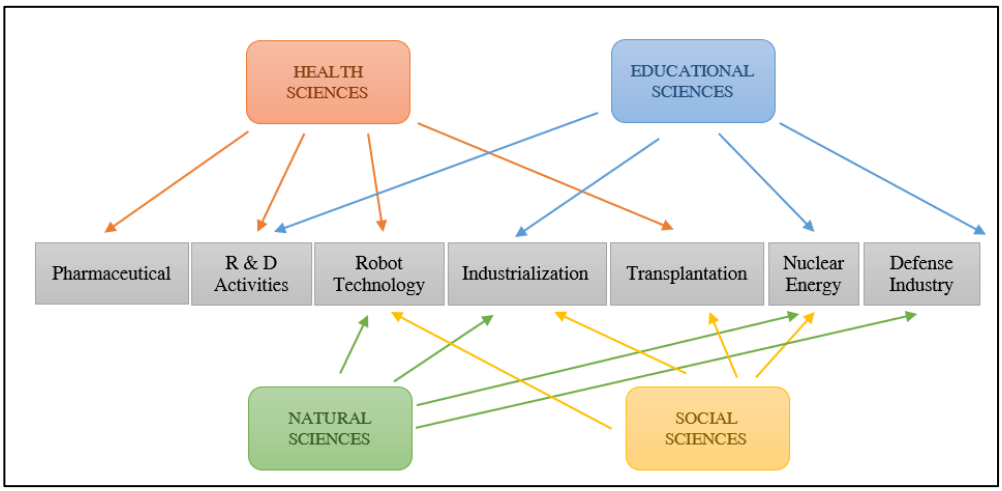
- Academics studying in the field of health sciences have stated that science has developed in the fields of biotechnology, robotics, nanotechnology, artificial intelligence, and space travel. A05 coded participant stated his/her opinion about this situation: "*Innovations in the biotechnological field such as the creation of artificial organs, in vitro fertilization, and genetic transformations, have been important in terms of health development*".

• Academics studying in the field of natural science expressed that 'in the field of quantum mechanics, nuclear energy, teleportation, biotechnology, and space travel, the science is developed. A19 coded participant described his/her opinion about this situation as: "*Because of the studies of Planck and Einstein, quantum mechanics studies that were encountered at the beginning of the 20th century have come to high-level formations today. The thinking that scenes we've seen in science fiction films for years will come true, creates new flashes in my horizons about the points where science will come*".

• Academics studying in the field of educational sciences have expressed that science has developed in the fields of quantum mechanics, nuclear energy, robotics, alternative energy, and artificial intelligence. A39 coded participant stated his/her opinion as: "*In line with the energy needs of societies, the search for new and effective energy resources has led to the orientation of structures such as nuclear energy and alternative energy sources*". Academics studying in the field of social sciences have stated that science has developed in the fields of teleportation, biotechnology, robotics, and nanotechnology. A33 coded participant expressed his/her opinion: "*Using Horizon 2020 or Industry 4.0 platforms we have information about robot technology, nanotechnology, and biotechnology concepts, I think that the work is carried out around the world.*"

The sixth theme of the research was asking the academics about "the development of science in Turkey" and "In which fields, science is developing in our country?". The data obtained from the participants are presented in Figure 7.

Figure 7. *The Views of Academics about the Development of Science in Turkey*



As Figure 7 illustrates, the views of academics on the development of science in Turkey are gathered under seven different headings: R&D Activities, transplantation, defense industry, robot technology, nuclear energy, pharmaceutical, and industrialization.

• The academics, studying health science, mentioned that science has been developed in the fields of R&D activities, transplantation, robot technology, and pharmaceutical. A47 coded participant stated his/her opinion as: "*I can say that the studies on science in Turkey are more tendencies to follow what is done around the world. For this reason, studies are more focused on research and development themes. I know we're in pretty good condition only about organ transplants. I am aware of the existence of those who come to our country only for this process in various countries. Recently, it has been widely seen that existence of studies for the use and creation of smart drugs*".

• Academics studying in the field of natural sciences have stated that science has developed in the field of the defense industry, robot technology, nuclear energy, and industrialization. A01 coded participant stated his/her opinion as: "*Although there is a lot of speculation about nuclear energy and even negative opinions by the public, the idea of having energy has led to our orientation towards nuclear energy. Within this orientation, factors such as mechanization and robotic applications, as well as manpower, need to be developed*".

• Academics studying in the field of educational sciences have stated that science has developed in the field of R&D activities, the defense industry, nuclear energy, and industrialization. A17 coded participant stated his/her opinion as: "*The studies, which are expressed as R & D, are generally based on the need for energy*

and industrialization. From the defense industry to the process of mechanization in agriculture, in many areas, such studies find their places".

- Academics studying in the field of social sciences have stated that science has developed in the field of organ transplants, robotics, nuclear energy, and industrialization. A64 coded participant stated his/her opinion as: "*When I came across this question, it came to my mind, the promises, especially in the newly opened educational institutions. I think that the students will be studying in such areas as the construction of the next fifty years, along with applications such as robotics and coding education. When I also think of this way of understanding all over the world, I consider it normal to have situations like nuclear energy, robot technology, and mechanization in industry, in our country*".

DISCUSSION AND CONCLUSION

Academics have been shown to frequently employ book definitions when describing the idea of science. Academics were anticipated to assemble under similar themes for the idea of science and incorporate book definitions, given the universality and semantic and conceptual infrastructure of science. This condition is supported by the participants' attitudes toward science, which include efforts to explain and investigate the cosmos as well as statements about helping the individual and society. When the literature was on the subject, graduate students recognized the concept of science (Kurtdede-Fidan & Konak, 2016). They describe the cosmos, social, cultural, and technical advancements, and concentrate them on the dimensions of benefitting mankind. In this regard, the study done by Kurtdede-Fidan and Konak (2016) was found to be parallel to the study. On the other hand, academics were perceived to bring some notions to the fore depending on the faculty variable they served. Academics working in the field of health sciences solve problems gather evidence, and practice medicine; academics working in the field of social sciences reason and experience; academics working in the field of a science experiment, observe, and find Academics in the field of educational sciences have been shown to have privatized the ideas of issue, process, and innovation. It is considered that research-study areas and the terminological use of ideas within these areas influence the creation of related concepts. Academics in the field of health sciences describe the process in the context of the disease, consider how to solve the disease based on this scenario, and gather proof by doing the necessary exams for the presence of the disease to support the relevant thinking. Similarly, academics working in the field of science place a premium on methods like experimentation and observation, which they frequently prefer during the research and experimentation process, which is based on variables specific to their research fields, revealing the impact of academics' book definitions and terminology in research-study areas in defining the concept of science. In this regard, DiGironimo (2011) underlines the need of providing science-society-environment interaction to define and make comprehensible the notion of science, as well as to explain the diversity in definitions of the concept of science by academics working in various domains. Furthermore, based on McComas (2002)'s definition of the idea of science, the focus on epistemological values and perceptions, i.e., the aspect of individuality, explains the similarities and variations in the concept of science concerning this research. The reason natural science academics came to this conclusion is that they are continually engaged in exploring this issue by pondering natural changes (Ruby & Decety 2004). According to Ari (2010)'s research, science prospective instructors define science as a product of living, inquiry, and questioning for the benefit of mankind, to sustain and progress their existence, as well as an attempt to comprehend oneself and the cosmos. It was observed that potential social science instructors were focused on comprehending and commenting on the science. Based on these findings, academics in this field have always been able to manage the instances that have come their way and continue their research in this manner. Most academics in the Department of Architecture have been seen to be focused on the observation of experiments and observations, depending on their beliefs on the concept of science. The reason architects have such a strong attitude toward science may be because their occupation requires them to constantly experiment with things. It was discovered that most academics in the engineering department focused on comprehension and interpretation when it came to the concept of science. The rationale for this conclusion is that artists may be constantly trying to propel their civilization ahead (Czarniawska, 1998; Gabriel, 2004) Scientists, social scientists, and academics in the engineering department may focus on understanding and interpreting code because they are attempting to make sense of nature, social scientists are attempting to make sense of society and structure, and academics in the engineering department are attempting to make sense of the products that occur within their departments. It's possible that the goods put through trial and error by the academics in the department of architecture in selecting the experimental observation code were beneficial. The reason why artists focus on the code of utility for mankind can be deduced from their departments: they are attempting to advance by placing society at the heart of their efforts. When academics' ideas on the

connotation of science are explored, it is found that scientists place a greater emphasis on inquiry and questioning in the connotation of science. The reason for this is that natural scientists strive to investigate every event in nature through the lens of their department. It was discovered that social scientists, like natural scientists, concentrated on studying and questioning in the context of science. The reason for this outcome might be attributed to the fact that social scientists are constantly studying society. Students highlighted the expression of utility in their impressions of science in research done by Uslu, Kocakulah, and Gur (2016). As can be observed, there is no resemblance between the work done and the research indicated above. The academics in the engineering department appear to be focused on science connotations, with the bulk focusing on innovation. This conclusion may be due to the academics in this department's ongoing efforts to create innovative technological items. While the professors in the department of architecture have a scientific bent, it was discovered that most of them are focused on innovation. The reason for this conclusion might be related to the nature of its departments, which are constantly attempting to come up with fresh ideas to stand apart. It was discovered that most academics in the art department identify science with experimentation and observation. This conclusion may be reached since they are always attempting to develop new items. Taking all of this into account, it can be stated that natural scientists study nature and the events that occur in nature, social scientists study changes in society and society, and researchers study research and inquiry procedures to learn about society and its changes. This may be because academic engineers and architects were focused on innovation to make a difference in their fields, continuously pushing to build new goods. Furthermore, it may be stated that academics who are artists were focused on the experiment and observation code, because of which they regard science to be merely experiment and observation. When academics' ideas on the origin of science were explored, it was discovered that they focused mostly on the concept of curiosity. The cause for this outcome might be attributed to natural scientists' efforts to learn about natural events and circumstances. Mar (2011) found that there is always science and the reality of knowing that evolved due to man's curiosity about himself and his cosmos in their study on the birth of science.

It has been observed that social scientists, like scientists, have stressed the idea of curiosity in understanding the birth of science. The reason for this might be that social scientists work hard to learn about new and complicated events in society and their causes. It has been observed that while discussing the birth of science, academics in the engineering department mostly concentrated on the notion of curiosity. Academics from engineering departments may be the source of such a conclusion since they are always studying and eager to produce new advancements to think about the future. Academics from the architectural department have been seen emphasizing curiosity, quest, and requirement while discussing the origin of science. When describing the origin of science, professors in the art department frequently highlight the notion of curiosity. Artists' interest to explore all that is going on around them, having a unique spirit, and preventing imitation may be the cause for such a judgment. Considering this, all academics focused on the code of inquiry, but academics in the department of architecture were also searching for and requiring codes. The reason for this may be seen in the fact that in the items they manufacture, they prioritize human needs and develop a variety of products to satisfy those requirements. When academics' views on the good and bad parts of the research generated are investigated, natural scientists have voiced views in both directions. The explanation for this conclusion might be caused; it is possible to say that natural scientists and the framework of their department are both parts of their output. It has been found that social scientists' perspectives on scientific creation may be both good and negative. The rationale for this conclusion is that it is possible that academics in this department, because of their interest in society, communicate their thoughts by thinking about how the products of research will have a greater impact on society. Academics in the engineering department have been observed emphasizing the code as having "both positive and bad aspects." This might be because scholars in this sector can consider both ways about the items they create. It has been observed that academics in the department of architecture and other fields have underlined the code as having "both good and bad aspects." This might be due to their professional attention to the consequences of science products, particularly on humans, due to the foregrounding of human needs. Although there is no majority, academics in the art department have focused on the codes "what makes science bad is the objective of man" and "negative elements of science as well as good aspects are available." The cause for this conclusion might be attributed to academics from this field who have focused on the human component more than anything else. Science's outcomes are bad, as "it has led mankind to a place where it cannot fathom." "It has seized many of humanity's principles and turned them into chaos," says the author. As can be observed in this study, the negative aspects of science are stressed. However, both good and bad elements of science were acknowledged in our study. Based on these findings, it's clear that several academics, including natural scientists, social scientists, engineers, architects, and artists, focused on the code "both bad and good parts of science are available." It has been observed that several artist academics have focused on the code "what makes science bad is man's objective." When the examples offered by academics were investigated to

determine if they were connected to the good or bad parts of science, it was discovered that natural scientists focused on activities in medicine, positive aspects of atom breakdown, and nuclear energy codes. As an example, they seem to have focused on the coding of the bad actions of the atomic bomb. They may have come to this conclusion because they're acting within the confines of their departments. According to Balki, Coban, and Aktas (2003), most students decided that they concentrated on the treatment of disorders associated with science's positive aspects. This outcome is consistent with natural science professors' responses. It can be observed that they focused on medical and technology codes as an example of social scientists, as well as the science's good aspects. They appeared to be focused on the negative aspects of the atomic bomb (Hiroshima and Nagasaki) code. The academics in this department may have reached this conclusion because they place society at the core of their research and, as a result, deal with issues that influence society. It has been observed that engineering academics focused on instances such as the "medicine" code as a good side and the "negative activity of the atomic bomb" code as a bad side. This might be because academics analyze the consequences of the goods, they make in their profession on society by thinking both ways. Academics from the architecture department were found to be focused on the positive side of the code "medicine," the negative side of the code "negative activity of the atomic bomb," and the negative side of the code "weapons used in war and negative activities of technical instruments." It is possible that this conclusion was reached because academics were more interested in contemporary concerns, causing society to be impacted. Academics from the art department have been observed focusing on the positive side of the code "manufacturing of medical devices." They appeared to be focused on the negative aspects of the atomic bomb (Hiroshima and Nagasaki) code. The reason for this conclusion may be that the artist was particularly interested in issues that were important to society.

The scientist, according to teacher candidates, is someone who examines events and facts in the universe, investigates the source of the mystery underlying it, tries to understand the causes of this mystery, simplifies what he understands, and publishes it in a way that the public can understand (Lin-Siegler et all., 2016). According to the findings of the study, academics from natural science departments are mostly focused on the research-inquiry codes. The reason for this conclusion may be that natural scientists, like scientists, utilize inquiry to grasp what is going on around them and the facts of nature and to arrive at concepts and hypotheses that help them explain what they see. As a result, it can be shown that the above-mentioned teacher candidates and natural scientists had similar definitions. Ari (2010) employed close expressions about the scientist when interviewing prospective science teachers and classroom teaching applicants. Consequently, scientists possess characteristics such as researcher, objective and creative mentality, critical thinking, and persons who ask questions. Prospective science teachers and classroom teacher candidates provided comparable responses to natural scientists' academics. It has been observed that social scientists have placed a strong emphasis on the "research and inquiry" code. This conclusion may be reached because social scientists study society and the events that occur within it, as well as the causes and repercussions of these occurrences. Because of Senel and Aslan's (2014) study, teacher candidates have described scientists as persons who have done important work for mankind, which is distinct from what we've done. Academics from the engineering department were observed concentrating on "expert" code. The explanation for this finding might be that when the academics in this department's working conditions are inspected, they aim to major in their departments by continually exposing various things. Academics from the architecture department were observed concentrating on the "research and inquiries" code. The explanation for this conclusion might be that architects, such as engineers, are always conducting a study to unveil new items or make a difference. Academics from the art department, like those from other disciplines, focused on "research and querying" code. The reason for this conclusion might be that an artist who wants to reclaim his identity must be prepared to work for many years, be free of the influences of other artists, and conduct an ongoing study to develop a unique aesthetic. Based on this, it can be inferred that natural scientists, social scientists, architects, and artists focused on the "research-questioning" code in their opinions regarding the definition of "science" since they are researching when dealing with any issue inside their respective departments.

When academics' opinions on the term' scientist' were explored, it was discovered that natural scientists focused on the 'Aziz Sancar' code. The rationale for this conclusion might be because the individual described has won a Nobel Prize. It has been observed that social scientists have focused mostly on the 'Aziz Sancar' code. This might be because social scientists see daily happenings since they are part of society. Academics from the engineering department were found to be mostly focused on the 'Nikola Tesla code. This might be because the engineers believe Nikola Tesla is closer to them because of his technological creations. It was discovered that academics from the architecture department focused mostly on the 'Aziz Sancar' code. The explanation for this conclusion might be that architects keep up with current events, and Aziz Sancar's work is at the forefront right

now. Academics from the art department were also largely focused on the 'Aziz Sancar' code. The reason for this conclusion might be because, as previously said, Aziz Sancar's work is at the forefront. Based on all of this, it's clear that most academics focused on the 'Aziz Sancar' code. This conclusion might be because Aziz Sancar is at the vanguard of his work, has won the Nobel Prize, and academics monitor everyday occurrences in such a way.

When academics' thoughts on the growth of science throughout the world are analyzed, natural scientists focused on the 'space science' code. When looking through the literature, some studies come to similar conclusions (Fivush & Nelson 2004; Klein 2015; Schacter, Addis, & Buckner, 2007). This might be because natural scientists deal with astronomy in their profession, and space research is at the forefront. It was discovered that social scientists focused on the 'space science' code as well. This might be because social scientists keep track of daily happenings. As a result, science in the subject of space exploration is progressing globally. Because of space research, advancements in other domains such as medicine, physics, chemistry, biology, and industry may be seen. Academics in the engineering department have been noted to voice their views mostly about medicine. Academics have played an essential part in the creation of novel procedures and instruments to be employed in the diagnosis and treatment of illnesses for many years, because of their respective disciplines. It has been seen those academics from the architecture department, namely engineers, have focused on the 'medicine' code. The explanation for this might be that architects are required by their departments to keep a careful eye on everyday events around the globe (Zeliadt, 2013). Academics from the art department have traditionally focused on the 'defense industrial' code. The reason for this conclusion might be that many nations are at war now because of their geopolitical location, and society is impacted by works created by artists who are inspired by the geography and the characteristics of the age in which they live. Based on these findings, it's clear that academics from natural sciences focused on the 'space science' code that is relevant to their field. It might be argued that social scientists chose this coding because they are interested in current events. When we look at the departments of architecture and engineering, we can see that both departments are focused on the 'medicine' code for this reason; engineer academics choose this code because of the products that they produce related to their department, and architecture academics choose this code because they follow daily events, to put it another way. Finally, art department academics focused on the 'defense industrial' code. The rationale for this judgment is that they are attempting to influence society through the works they have exposed, and the way society monitors regular occurrences.

When academics' views on the growth of science in certain areas in Turkey are analyzed, natural scientists are mostly focused on the 'industrialization' and 'defense industry' codes. The explanation for this conclusion might be that Turkey can make mandatory changes owing to its geopolitical location, and academics in this department keep up with everyday happenings. It's possible that social scientists focused on the 'natural scientist' code because they compete with the natural science department and express it at every chance, and they believe that in Turkey, their discipline is not given enough attention. Academics from the engineering department were found to be mostly focused on the 'defense industry' code. This situation: perhaps because they are very interested in technology items that are relevant to their sector and are now a hot topic. As can be seen from the following: Turkey expanded investment in the military sector, and academics have been proven to respond as a 'defense industry', considering the circumstances. Academics in the architectural department have been observed concentrating on the 'medicine' code. This situation may exist since our country is well-known in medicine and serves as an example to other countries. It might also be because the professors in this area keep a careful eye on advancements, particularly in medicine. Academics from the art department were likewise largely focused on the 'defense industrial' code. This might be because, as previously said, artists closely watch the turmoil of society to create works that impact society. Those R & D activities in advanced application areas, such as biotechnology, gene engineering, software, information and communication technologies, new materials, space science and technologies, nuclear technology, utilization technologies from seas and submarines, great science, and clean energy technologies, were expressed in the study conducted by Ciftci (2004). According to the findings of this study, knowledge advances not only in the fields of medicine and defense. According to the above-mentioned survey, science is progressing in several fields in Turkey. As a result, it differs greatly from our research. When a conclusion is drawn based on all of this, the fact that scientists, engineers, and artists are focused on the "military sector" may be impacted by the turmoil in our nation owing to its geopolitical location. However, when comparing departments, this may be because professors in the science and engineering department are interested in items utilized under the code of “defense industry”. Social scientists may be focusing on the 'natural science' code because they believe they are less significant in Turkey and that there is more research on natural science.

Implications

- When the obtained data are examined, it is seen that academics frequently use the definitions in scientific books when defining the concept of science. Additionally, it is seen that the academics present common ideas about explaining the universe and providing benefits to society. On the other hand, it is seen that the department variable in which academics work is effective in revealing information that is not common in defining the concept of science. In this sense, the following implications are offered to academics and researchers; (i) The opportunity should be provided for academics to make sense of terminological concepts non-area and to gain an interdisciplinary perspective. (ii) The effect of the department in which academics work on the process of defining the concept of science can be examined in depth and research can be carried out on the variables that may have an impact.

- When the opinions of academics towards the concept of scientists are examined, it is seen that the department in which academics work, actuality, and popularity factors have an effect. The fact that popularity and actuality influence the concept of a scientist is an indication that the elements of the nature of science are internalized by academics. The fact that the department variable in which academics work affects the concept of the scientist is due to the similarity between the scientist's and the academic's field of study and scientists have made scientific contributions in the relevant field. In this sense, academics can be taught awareness about scientists who carry out studies in different fields and their contributions to science.

- When the opinions of academics on the possible scientific developments in the world and Turkey are examined, it is seen that a common idea about robot technology has been formed. Concordantly, it is necessary to raise awareness among scientists, academics, researchers, and society about the nature, development, and use of robot technology. On the other hand, while the necessity of space-related studies in the world for the development of science is emphasized, the necessity of studies on industry and defense in Turkey is emphasized. It is thought that the criteria needed by societies and geopolitical positions have an impact on the emergence of this situation. In this sense, the following implications are offered to researchers; Research can be carried out by comparing the opinions of academics working in different countries about scientific development. Thus, the role of the social need factor and the importance of geopolitical position in the process can be revealed more deeply.

Statements of Publication Ethics

Ethical principles were followed in this study. The necessary ethical approval was obtained from Trabzon University Social and Human Sciences Scientific Research and Publication Ethics Committee dated 13/02/2023 with the decision number E-81614018-000-2300011184.

Researchers' Contribution Rate

The first author is responsible for organizing the research process, establishing the conceptual framework, and collecting the data. The second author is responsible for organizing the research process, collecting the data, and transcribing the data. The third author is responsible for organizing the research process, analyzing the data, and creating and interpreting the findings.

Conflict of Interest

There is no conflict of interest for this study.

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Evaluating Orienteering-Based Guidance Material on Mitosis and Meiosis

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Abstract

This study aims to obtain science teachers' opinions about developing an orienteering-based guidance material for the 7th-grade subjects of mitosis and meiosis and using this developed material in teaching. The research uses the case study design, a qualitative research method. The research was carried out with 10 science teachers working in public schools in Turkey in the 2020-2021 academic year. A document with 17 open-ended questions prepared by the researchers was applied to the participants online. Content analysis is used for analyzing the data. The study has determined the codes, categories, and themes related to the data obtained from open-ended questions, presenting the findings as direct quotations without interpretation. As a result, the research has concluded teachers to want to use the developed guidance material in their lessons and receive training on this subject and to consider the material suitable for their students' grade and able to contribute to the students' learning. It is recommended to apply the opinions of teachers and students in future studies.

Keywords: mitosis, meiosis, guidance material, orienteering.

Mitoz - Mayoz Bölünme Konularında Geliştirilen Oryantiring Temelli Rehber Materyalin Değerlendirilmesi

Öz

Bu çalışma, 7. sınıf mitoz ve mayoz konuları için oryantiring temelli bir rehberlik materyali geliştirilmesi ve geliştirilen bu materyalin öğretimde kullanılmasına yönelik fen bilimleri öğretmenlerinin görüşlerini almayı amaçlamaktadır. Araştırmada nitel bir araştırma yöntemi olan durum çalışması deseni kullanılmıştır. Araştırma 2020-2021 eğitim öğretim yılında Türkiye'de devlet okullarında görev yapan 10 fen bilimleri öğretmeni ile gerçekleştirilmiştir. Araştırmacılar tarafından hazırlanan 17 açık uçlu sorudan oluşan bir doküman katılımcılara online olarak uygulanmıştır. İçerik analizi, verileri analiz etmek için kullanılır. Çalışmada açık uçlu sorulardan elde edilen verilere ilişkin kodlar, kategoriler ve temalar belirlenmiş, bulgular yorum yapılmadan doğrudan alıntılar şeklinde sunulmuştur. Sonuç olarak araştırma, öğretmenlerin geliştirilen rehberlik materyalini derslerinde kullanmak ve bu konuda eğitim almak istedikleri, materyali öğrencilerinin sınıf düzeyine uygun ve öğrencilerin öğrenmelerine katkı sağlayabileceğini düşündükleri sonucuna varmıştır. Gelecekte yapılacak çalışmalarda uygulama gerçekleştirilerek öğretmen ve öğrenci görüşlerine başvurulması önerilir.

Anahtar kelimeler: mitoz, mayoz, rehber materyali, oryantiring.

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INTRODUCTION

Developments in science and technology have affected almost every stage of our lives, especially education. Education systems have had to constantly keep track of innovations in order to keep up with the changes and developments in the field of science and technology. Some innovations are needed in the education system as a result of higher teaching standards, greater numbers of students in classrooms, and rapid technological developments. The constructivist approach, which supports the learning of subjects that are intertwined with technology, such as mathematics and science, which are the subjects that students have difficulty in constructing by educators, is one of these innovations (Gilbert, 2018; İsman et al., 2002). As a student-centered approach, the constructivist approach requires students to learn content by doing and experiencing, to discover information, to realize learning based on discussion and research, and to be active in the classroom. The teacher is positioned as a guide for students to access the information in this process (Jia, 2010).

Science is a course that teaches the basics of science and technology. Science forms the basis of a good education (İsman et al., 2002). In this context, students should be given a solid understanding of science, which can happen through competence in science education (National Research Council, 2012). Competence in science education requires students to learn by using the information they learn in their daily life through action and experience The information obtained as a result of these teaching activities should be far removed from memorization, and it should be meaningful and permanent (Rajan, 2012). A significant percentage of science teachers are seen to still prefer teacher-centered teaching methods in their lessons such as direct instruction and question-and-answer more often than student-centered teaching methods (Atila & Sozbilir, 2016). This situation brings along many problems such as lower student interest, motivation, and participation in the lesson because the lessons become monotonous. Teachers are expected to provide students with appropriate learning experiences rather than transferring information directly. In this sense, the teaching methods, approaches, and materials used in the lesson are thought to impact students' affective characteristics such as their attitudes toward the lesson, self-efficacy, motivation, and anxiety; these affective factors are also thought to affect student performance in the course and their academic success as a result (Peixoto et al., 2018). For this reason, teaching materials and use alternative methods and techniques need to be enriched in order to teach science concepts effectively (Grover & Pea, 2016). As a matter of fact, using different methods and techniques together is recommended in the science curriculum by taking into account students' individual differences (MoNE, 2018). At this point, the need comes to the fore for guidance materials that will help teachers and students (Tomlinson, 2013). Materials that can help meet these needs are called guide materials (Kaya, 2006).

Developing guidance materials is a time-consuming process that requires planned and scheduled work. Guidance materials developed within the framework of the unit can be assured to have many features not found in textbooks. Guidance materials that take students' prior knowledge and misconceptions into account, attract their attention, and include rich and numerous examples will make learning impactful (Senel Coruhlu, 2013). The guidance materials to be developed should be able to analyze the concepts related to the subject in detail, use models especially for teaching abstract concepts, provide students with one-on-one experiences, guide teachers and students, increase students' attitudes toward science, take into account students' individual differences, and contain different methods and techniques (Degirmençay, 2010).

One of these materials, orienteering, appeared in Scandinavia at the end of the 19th century; It started with the people of the region putting signs on certain routes to find their way under heavy snow and fog (Baster, 2020). With the development of technology over time, more detailed maps have been drawn, and orienteering has become the traditional sport of the country. Orienteering then developed and became a world sport. Orienteering is defined as a sport branch that increases students' problem-solving and analytical thinking skills and develops abstract-thinking and orientation skills by integrating physical movements with mental processes. Orienteering is an outdoor sport where check points on a map in a determined region are aimed to be completed as soon as possible; it increases individuals' ability to struggle with difficulties and solve problems independently by enabling the use of physical and mental processes together. Since orienteering includes many cognitive processes such as planning, thinking, remembering, recognizing, observing, making decisions, and problem solving (Johansen, 1997), it contributes to the mental development of the individual. Orienteering activities not only provide students with many benefits in terms of physical, mental, and educational aspects, but also allow students to develop individually and socially. Orienteering, which is easily accessible financially, also provides the excitement of competition and creates a competitive environment (MoNE, 2019). Additionally, orienteering requires individuals to think fast and determine the most appropriate route from one location to another. Therefore, orienteering has been described as

"playing chess by running" (MoNE, 2019). Orienteering can be integrated into many branches such as science, social studies, and mathematics by associated it with the learning outcomes in the curricula (Huikko & Raus, 2020; MoNE, 2019).

When examining the literature, a very limited number of studies on orienteering are found. While most of these studies are on physical education (Huikko & Raus, 2020; Jourand et al., 2018; Pulur & Akcan, 2017), other studies on orienteering are also found regarding geography education (Avcı, 2013; Imamoglu & Imamoglu, 2018; Tuna & Balci, 2013). However, no research is found regarding integrating orienteering into a science course.

Studies conducted on mitosis and meiosis generally investigate the effects of various teaching methods and techniques on students' academic achievement (Aksakal et al., 2015; Bedir, 2007; Karsli, 2015; Ozay, 2007; Ozbudak Kilicli, 2016; Ozkaya, 2013; Yucel, 2015), attitude (Bedir, 2007; Karsli, 2015; Ozbudak Kilicli, 2016; Ozkaya, 2013), and motivation toward science (Karslı, 2015). Various studies are seen to have aimed at detecting and eliminating the misconceptions of students from different education levels about mitosis and meiosis (Alkan et al., 2016; Alkan & Koksal, 2017; Akyurek & Afacan, 2012; Atilboz & Gokben, 2004; Aydin, 2011; Etobro & Banjoko, 2017; Kara, 2007). In addition, there are studies in the literature that use guide materials in the teaching of mitosis and meiosis. According to Karaca et al. (2021), benefited from card games. Alkan (2015), on the other hand, used a conceptual change model (material) for mitosis. The fact that students have many misconceptions about mitosis and meiosis reveals the necessity of the current study. The guidance material developed in this study will help teachers identify and eliminate the misconceptions that may occur within the scope of this subject. Within this context, the idea is that students will be prevented from carrying their misconceptions about the subject to future grades.

This research is thought to benefit teachers, students, academicians, and MoNE. The developed guidance material is thought able to guide teachers and students in terms of having rich teaching content, including applicable teaching activities, providing students with the opportunity to apply the theoretical knowledge they have acquired in daily life, revealing abstract concepts concretely, and incorporating contemporary methods and techniques in science education. In addition, this guide material, which is thought to be of such benefit to students, is expected to guide teachers in teaching mitosis and meiosis, and to be a material that they can use in a planned and programmatic way in their lessons. These materials are expected to be a resource for academicians for research on different courses and subjects related to orienteering. Orienteering is thought to be an activity that can be included in 7th-grade textbooks as a contribution to the MoNE. In addition, this research, can be considered among the first on orienteering and science course integration and is expected to be a source for future research. 7thFor these reasons, the aim of this study is to develop an orienteering-based guidance material for the subject of mitosis and meiosis in the 7th-grade science curriculum and to refer to the predictions of science teachers about whether this material can be used in teaching. In line with this purpose, the research question has been determined as "How are science teachers' views about the orienteering-based guidance material developed for mitosis and meiosis?"

METHOD

Research Design

This study uses case study design, a qualitative research design. In the case study, the researcher investigates in-depth information, describes situations, or creates themes at specific times using multiple sources of information such as observations, interviews, and documents regarding daily life or limited situations (Creswell & Poth, 2016). Because the present research aims to develop a guidance material for the subject of mitosis and meiosis and to have science teachers evaluate this material, it is thought that this aim will be achieved through case study.

Study Group

The research was conducted with the participation of 10 science teachers working in Turkey in the 2020-2021 academic year. Convenience sampling was used to determine the teachers included in the study group. Convenience sampling aims to select individuals or groups that are easy to access (Fraenkel et al., 2012). In the determination of the participants, attention was paid to the fact that science teachers gave lectures at the 7th-grade level. In addition, information about orienteering was provided before asking for the opinions of the participants. In addition, participants have experience in the use of guide materials. The demographic information of the teachers is given in Table 1.

Table 1. Participants' Demographic Information

Participants	Age range (years)	Gender	Work experience (years)	Residential area of the school	Education level
P1	30-34	Male	1-5	City	Bachelor's degree
P2	50-54	Female	20 or more	City	Bachelor's degree
P3	25-29	Female	1-5	City	Bachelor's degree
P4	35-39	Male	10-15	City	Master's degree
P5	30-34	Male	5-10	Village	Master's degree
P6	20-24	Female	1-5	City	Bachelor's degree
P7	35-39	Male	10-15	City	Master's degree
P8	30-34	Male	5-10	City	Bachelor's degree
P9	30-34	Female	5-10	City	Master's degree
P10	35-39	Female	10-15	City	Doctoral degree

Developing the Guidance Material

This research develops a guidance material for the 7th-grade mitosis and meiosis subject. When developing the guidance material, the steps below were followed using the guidance material development stages determined by Bakioglu and Karamustafaoglu (2017):

1. One of the researchers took an orienteering certificate by participating in in-service training in order to improve his orienteering skills.
2. Before developing the guidance material, a literature review was conducted on new approaches in science education, the constructivist approach in science education, the subject of Mitosis and Meiosis, how to prepare guidance material, and orienteering.
3. As a result of the literature review, the students were determined to have difficulty associating mitosis and meiosis with daily life and to have misconceptions about this subject (Akyurek & Afacan, 2012; Alkan et al., 2016; Atılboz & Gokben, 2004; Bedir, 2007; Kara, 2007; Kaya, 2019; Ozay, 2007).
4. The decision was made to base the guidelines on the constructivist approach; the material was prepared in this direction.
5. The learning outcomes from the mitosis and meiosis subject in the science curriculum were analyzed. The decision was made to prepare a guidance material that involves all the learning outcomes of the subject.
6. While preparing the guidance material, attention was paid to features good guidance materials should have (McAlpine & Weston, 1994). These features involve the guidance material being target-oriented; the information being clear, accurate, and reliable; attracting students' attention; having high technological quality; being effective on students; encouraging students to use them; and being suitable for the grade level as well as for cognitive, affective, and psychomotor behaviors and collaborative work.

Appendix 1 provides the guidance material that was developed by taking the above steps into consideration as well as the guidelines regarding the material.

Classroom Environment

The arrangement of the classroom environment facilitates teachers and students in performing the orienteering activities. The researcher prepared the images in Figure 1 using 3D software. As seen in Figure 1, the rows are arranged so that the students can move freely and are numbered left to right then front to back from 1 (closest to the teacher's desk) to 26 (farthest from the desk). The boxes with the information cards were placed on the numbered rows, then the stopping points were determined. A suitable place in the classroom (the triangle located on the back wall of the classroom) has been determined as the starting point. This point is the first step required to start orienteering activities. A suitable place in the classroom (the circle on the teacher's desk) has also been determined as the end point. This point is the last step required for orienteering activities to end. Students put the passwords they have obtained from the information cards in the check box they have and bring them to the end point. In the activity related to the stages of mitosis, the student will read the information cards (Appendix-2) on the relevant desks, select the correct image (Appendix-3) on the table and attach it to the check box in Appendix-7. In the activity related to the stages of meiosis, the student will read the information cards (Appendix-4) on the relevant tables, select the correct image on the table (Appendix-5) and attach it to the check box in Appendix-8. The images in Appendix-3 and Appendix-5 were edited and used from the website

(https://www.shutterstock.com/image-vector/mitosis-process-by-which-our-bodies-160428437). In the activity on the characteristics of Mitosis and Meiosis, the student will read the information cards (Appendix-6) on the relevant tables, select the correct image on the table (Appendix-6) and attach it to the check box in Appendix-9. In the study, a sample classroom environment where the application can be made is illustrated. Under the leadership of the teacher who will implement the activity, changes can be made according to the environmental conditions.

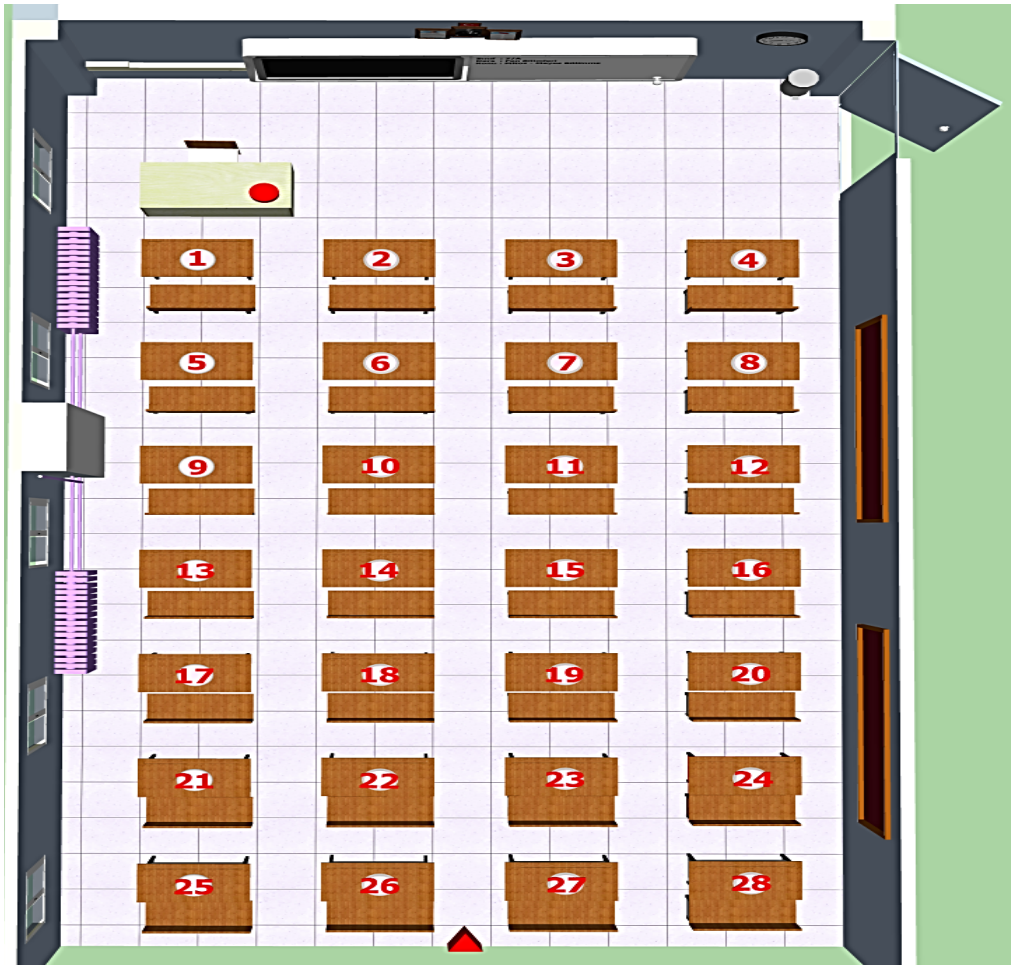

Figure 1. *The Classroom Environment Where the Guidance Material will be Applied*

Data Collection Tool

The most commonly used data collection tools in case studies on education are participant observations, in-depth interviews, and open-ended questions (Johnson & Christensen, 2019; Moser & Korstjens, 2018). In this study a document consisting of open-ended questions was used as a data collection tool. The researchers took certain criteria into consideration in the document they prepared as a result of the literature review (Gullu et al., 2019; Kutluca & Zengin, 2011; Yazlik, 2018). These criteria are generally about the instructional features of the developed guidance material and the positive and negative reflections on how to use this material in teaching. A draft document was formed first, and the opinions of a science education expert was taken in person and a Turkish teacher's opinions were received online.

A face-to-face interview was held with a science education expert regarding the draft document and some changes were made in the document in line with expert opinions. As a result of this interview, necessary arrangements were made considering the appropriateness of the evaluation of the material by the teachers in terms of different dimensions. For example, classroom discipline of the developed material, communication with the student, etc. The questions asked about its effect on the subjects were gathered in a single question and asked as its effect on classroom management. The questions in the document are divided as follows: The 1st and 2nd questions are classified as the student dimension; questions 3, 4, 5, 6, 7 and 8 are in the dimension of the teacher; questions 9, 10, 11, 12, 13 and 15 are in the lesson dimension; and questions 14, 16 and 17 are in the material dimension. As a result of the online interview with the Turkish teacher, the document was finalized after making

the necessary following arrangements in terms of miswriting, expression errors, and understandability regarding the draft document:

The word "a contribution" should be removed from the Question 7 (Do you think the developed guide material will make a contribution to you?), and the question should be revised as “Do you think the developed guide material will positively contribute to you?”

Question 15 states, “What do you think about adapting the developed guidance material to other topics?” and should be changed to “What do you think about the adaptability of the developed guidance material to other topics?”

Validity – Reliability

Internal Validity

Internal validity of a research implies the researcher’s consistency from the data collection process to data analysis and interpretation; it expresses the clear explanation of this consistency (Fraenkel et al., 2012). Within the scope of this research, the following precautions regarding threats to its internal validity have been taken:

Interviews were held to get the opinions of a science education expert and a Turkish teacher about the prepared draft document in order to evaluate the readability and understandability of the questions.

The document was hand-delivered to the science teachers, and they were informed about the document.

The findings include direct quotations regarding the science teachers’ statements of science teachers.

- This study did not triangulate the data, which is thought to be a threat limiting its internal validity.
- Meaningful codes, categories, and themes were determined as a result of the content analysis. Meaningless and irrelevant statements were not included in this analysis.
- The codes, categories, and themes were finalized through face-to-face interviews with a science education expert.

External Validity

A study’s external validity expresses the generalizability of the research results (Fraenkel et al., 2012). The following precautions were taken regarding threats to its external validity:

- The research steps are explained in detail.
- Participants’ identities remain anonymous and encoded as P1 to P10.

Internal Reliability

A study’s internal reliability expresses different researchers arriving at the same results using the same data (Fraenkel et al., 2012). The precautions taken regarding threats to internal reliability are as follows:

- Findings in the documents are presented in their raw form without comments.
- The research purpose and question are stated clearly and understandably.

External Reliability

External reliability expresses similar data being available in environments akin to that in the research (Fraenkel et al., 2012). The following precautions have been taken regarding threats to external reliability:

- The research findings and discussion are expressed clearly and comprehensibly.
- The research findings are explained in line with the opinions of a science education expert.

Data Analysis

The data obtained have been identified using content analysis in an attempt to reveal the implicit truths in these data. Content analysis is a kind of in-depth and systematic analysis that allows researcher to examine human behaviors indirectly by analyzing written communication patterns (Fraenkel et al., 2012). The current study aims to analyze in detail science teachers’ answers to the documents. In line with this goal, the study investigates the data obtained from the documents and creates codes. These codes have been placed under specific categories. The themes were then obtained based on these categories. In this study, 17 categories were created. Based on these categories, the theme was determined as "Guidance materials". Next, a science education expert examined these codes, categories, and themes, reaching consensus with the researchers. The points to be considered while determining the codes, categories, and themes are as follows: The categories summarize the interview questions, the codes summarize the participants’ responses, and the themes summarize the research subject (Table 2).

Table 2. Themes, Categories and Codes Obtained from the Document

Theme	No	Category	Code
Guidance materials	1	Suitability to students' level	Suitable
		Reason for suitability	Creative thinking, brainstorming, meaningful learning, permanent learning, clarity, being suitable for learning outcomes, facilitating learning, including visual elements
	2	Students' ability to use	Usable
	3	Effect on classroom management	Effective uses, causes confusion, communication disorder, makes classroom environment fun, depends on class size, discipline problem, allows students to discover
	4	Difference from previously used methods and techniques	Different, effective, provides permanent learning, promotes active participation, remarkable, innovative, fun, collaborative, competitive, increases motivation, raises awareness
	5	Advantages	Provides permanent learning, promotes active participation, innovative, collaborative, enables quick thinking, develops map-reading skills, ensures repetition of the topic, increases attitudes, economical, easy to adapt, fun, raises awareness
	6	Disadvantages	Yes, no
	7	Contributes positively to the participant	Yes
	8	Desire to receive training	Yes, no
	9	Effect on course achievement	Provides permanent learning, increases achievement, increases attitudes, promotes active participation, provides repetition of the subject, provides feedback, increases motivation, develops high-level skills
	10	Effect on interest in the course	Increases
	11	Thoughts on its use in science teaching	Should be used
		Reasons for being used in science teaching	Facilitates subject teaching, concretizes, draws attention, student-centered learning, provides permanent learning, teaches with games, increases motivation, collaborative
	12	Suitability to course duration	Suitable, partially suitable, not suitable
	13	Problems that may be encountered	Lack of materials, discipline issues, complexity, bias, lack of time
	14	Purpose of use	Assesses readiness, teaches the subject, the end-of-unit assessment, providing repetition of the unit
	15	Thoughts on its suitability to the content (subject)	Suitable
	16	Adaptability to other subjects	Adaptable
	17	Missing/ improvable point(s)	Yes, no

Research Ethics

Ethics committee approval was obtained for the research.

FINDINGS

Findings Regarding the Appropriateness of the Guidance Material to the Level of the Student and its Reasons

The science teachers were asked *"What do you think about the suitability of the developed guidance material for the students' level? Why?"* All the teachers were identified to consider the material developed to be suitable for students' level (see Table 3).

Table 3. Answers Regarding the Reasons for Suitability for the Students' Level

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Creative thinking	X									
Brainstorming	X									
Meaningful learning	X								X	
Permanent learning		X				X		X		
Clarity			X	X	X					
Suitable for learning outcomes							X			X
Facilitates learning						X		X		
Includes visual elements		X								X

Stating the guidance material to develop creative thinking, P1 expressed that the material allows students to brainstorm and would be useful in realizing meaningful learning. Participants stated that the material provides permanent learning and facilitates students' learning the subject. In this framework, P8 stated, *"I found the material suitable for the students' level; I think it is easier and permanent for students in the target age group to learn when the course topics are gamified."* P4's statements were "*the explanations made for the students in the guide material are sufficient*". P10's statements are "*associated with student achievements. Visual elements are included*".

Findings Regarding the Guidance Material's Effect on Classroom Management

Science teachers were asked, *"What do you think about the effect of the developed guide material on classroom management (e.g., discipline and communication)?"* The answers are given in Table 4.

Table 4. Answers Regarding the Guidance Material's Effect on Classroom Management

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Effective use	X								X	
Causes confusion		X			X	X				
Communication disorder			X	X	X			X		X
Makes classroom environment fun				X						
Depends on class size							X			
Discipline problem								X		
Allows students to discover								X		

Participants stated the material to cause situations such as effective use in classroom management, confusion, and increased communication. P8 expressed this situation as:

"When applying the material, the fact that the students are in constant communication with each other seems to be a negative situation in terms of maintaining classroom discipline, but this situation can be eliminated with appropriate guidance from the teacher. Also, having the teacher discover students' different characteristics is useful as a result of externally observing the students in the game."

Findings Regarding the Differences from Previously Used Methods and Techniques

The participants were asked, *"What kind of differences do you expect when you compare the developed guide material with the methods and techniques you've used before?"* The answers are given in Table 5.

Table 5. Answers Regarding the Differences from Previously Used Methods and Techniques

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Different	X									
Effective	X						X			
Provides permanent learning		X						X		
Promotes active participation			X					X		
Remarkable			X							
İnnovative				X	X					
Fun				X					X	
Raises awareness					X			X		
Collaborative						X				
Competitive						X				
Increases motivation										X
Raises awareness										X

The prepared activity is seen to differ from the methods and techniques the teachers had previously used. Stating the material to provide more permanent learning, P2 expressed his/her opinion as, *"I think it is able to make learning more permanent."* Some participants stated the activity to support active participation and to be remarkable (P3), innovative (P4) and fun (P4). In this regard, P4 stated, *"I think it is a new technique which seems more fun than the techniques I use."* Expressing the activity to be one that offers students both a collaborative and competitive environment, P6 stated, *"I think the activity enables students to experience both working in cooperation and in competition by addressing students through different aspects."* Thinking the activity to be different in how it increases motivation and creates awareness in students, P10 said, *"I think it will improve students' motivation to learn and enable them to learn better. Thanks to this game, students can complete deficiencies in their own learning."*

Findings Regarding the Advantages of the Guidance Material

The participants were asked *"What do you think about the advantages of the developed guidance material?"* The answers are given in Table 6.

Table 6. Answers Regarding the Advantages of the Developed Material

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Provides permanent learning	X	X	X							
Promotes active participation			X		X		X	X		
Innovative				X						
Collaborative					X	X				X
Enables quick thinking					X				X	
Develops map-reading skills					X					
Ensures repetition of the topic						X				
İncreases attitudes						X			X	
Economical								X		
Easy to adapt								X		
Fun				X		X				X
Raises awareness										X

According to the participants, the developed material has advantages such as it provides permanent learning, promotes active participation, is collaborative, enables quick thinking, and develops map-reading skills. Regarding the advantages, P5 stated, *"I believe it offers many contributions such as active participation, cooperative learning, quick thinking, and map-reading knowledge"* and P6 said, *"This material is advantageous in terms of teaching students to work cooperatively, providing repetition of the subject, and increasing interest and attitude toward the course."* P4's statements were "*I think its biggest advantage is that it is a new technique used in the lessons. I also think it will attract students' attention*". P8's statements are "*Economic, student-centered, the number of students is not an obstacle because different places can be used, and it can be easily adapted to different subjects*". P10's statements are: "*A subject that is difficult to learn can be taught by making it fun. Thus, students reinforce their own learning and learning together with the group*".

Findings Regarding the Disadvantages of the Guidance Material

The teachers were asked, *"What do you think about the disadvantages of the developed guide material?"* Two participants saw no disadvantages (P1 and P2), while eight participants stated it could be improved (P3, P4, P5, P6, P7, P8, P9 and P10). Stating the material to be disadvantageous in that applying them in crowded classrooms is difficult, P4 said, "*The difficulty in applying it in crowded classrooms can be a disadvantage.*" P1 made a statement as "*I do not see any disadvantages*".

Findings Regarding the Guidance Material's Contributions to the Participant

The participants were asker, *"Do you think the developed guidance material positively contributes to you?"* All teachers were seen to think the developed material positively contribute to them. On this subject, P5 stated, "*Different methods and techniques contribute positively to my professional competence; I am also thinking of designing activities at different grade levels by participating in the trainings based on these activities.*"

Findings Regarding Desire to Receive Training on the Guidance Material

The participants were asked, *"Would you like to receive training on the developed guide material?"* Nine teachers answered this question in the positive. Meanwhile, P7 expressed not wanting to receive training, saying, "*I can implement this without any training.*"

Findings Related to the Guidance Material's Effect on Course Achievement

The participants were asked, *"What do you think about the developed guidance material's effect on course achievement (teaching the subject)?"* Their answers are given in Table 7.

Table 7. Answers Regarding the Developed Material's Effect on Course Achievement

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Provides permanent learning	X		X	X		X	X	X	X	
Increases achievement		X		X	X	X				
Increases attitude					X	X				
Promotes active participation					X					
Provides repetition of the subject						X				
Provides feedback								X		
Increases motivation										X
Develops high-level skills										X

P6 thought the developed material to have affected course achievement in terms of providing permanent learning, increasing achievement, raising attitudes, and providing subject repetition and stated: "*I think the success of the course will be directly affected by lifting students' attitudes. In addition, if we consider it in terms of being an effective method for subject repetition and evaluation, I think it will increase the subject's memorability and thus course achievement as well."*

Stating the material to affect course achievement in terms of increasing motivation and developing high-level skills, P10 said, "Student motivation and desire to learn increase. It develops higher-level skills."

Findings Regarding the Guidance Material's Effect on Interest in the Course

The participants were asked, *"What do you think about the developed guidance material's effect on interest in the lesson?"* All participants stated that the material increases interest in the lesson, which P9 stated as *"Because students like to be active and use materials in the lesson, their interest is high."*

Findings on the Use of Guide Materials in Science Teaching and Its Reasons

The participants were asked, *"Do you think the developed guidance material should be used in science teaching? Why?"* All teachers stated that the developed material should be used in science teaching citing different reasons (see Table 8).

Table 8. Answers Regarding the Reasons for Using the Developed Material in Science Teaching

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Facilitates subject teaching	X						X			
Concretizes		X								
Draws attention			X	X	X	X				
Student-centered learning								X		
Provides permanent learning									X	
Teaches withgames										X
Increases motivation										X
Collaborative										X

P1 stated that "*it provides easy teaching of subjects to children*". P2 stated that "it should be used to concretize the issues". P3 stated that "*I think that learning will also be provided because it will attract attention from students*". P8, on the other hand, stated that "*Since I have observed that student-centered teaching methods are more effective than classical methods in science teaching, I think that the developed guide material should be used in schools*". P9 stated that "*it will be positive for students to apply especially on subjects that are difficult to remember*". P10 stated, *"I think teaching with games is very necessary for abstract topics students have difficulty understanding. Thus, students can learn while having fun. Their motivation increases. They learn together by doing group work."*

Findings Regarding the Guidance Material's Suitability to the Course Duration

The participants were asked, *"What do you think about the developed guidance material's suitability for the course duration?"* Four participants found the course duration sufficient, four participants had concerns about this issue, and two participants found it insufficient (see Table 9).

Table 9. Answers Regarding the Developed Material's Suitability for the Course Duration

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Suitable				X			X	X	X	
Partially suitable	X	X	X		X					

Not suitable					X			X		

P7 stated the lesson duration to be sufficient by expressing, *"If the necessary preparations are made beforehand and the students are informed, the activity can be applied during the course hour,"* whereas P10 thought the lesson duration might be insufficient by stating, *"Extra time may be required for students to understand the game rules and work in teams."* P5 stated that *"one class hour will not be enough for large classes, but I think the course period is appropriate for an ideal class"*.

Findings Related to Problems That May Be Encountered

The participants were asked, *"What kind of problems might you encounter while using the developed guidance material in your lessons?"* The answers are given in Table 10.

Table 10. Answers Regarding the Problems That may be Encountered

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Lack of materials	X									
Discipline issues		X			X		X	X	X	
Complexity			X	X						
Bias				X	X					
Lack of time						X	X			X

The teachers are seen to think that problems such as lack of materials, discipline issues, complexity, bias, and lack of time may be encountered when implementing the activity. While P1 expressed this by saying, *"There may be a lack of materials"* and P4 stated, *"Some students may be biased, but they will adapt over time. They may have problems if I don't give enough explanations."*

Findings Regarding the Purpose for Using the Guidance Material

Participants were asked, *"For what purpose would you use the developed guidance material in the lesson?"* Their answers are given in Table 11.

Table 11. Answers Regarding the Purposes for Which the Guidance Material Will be Used

Codes	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Assessing readiness					X			X		
Teaching the subject	X	X	X	X	X		X		X	X
The end-of-unit assessment					X	X	X	X		
Providing repetition of the unit					X	X		X	X	

The participants stated that the material could be preferred especially for teaching the subject, and also stated that it could be used for assessing readiness, the end of unit assessment and providing repetition of the unit. P5 statements are "*I would use it to determine readiness, to teach the subject, to evaluate the end of the unit, to repeat the unit*".

Findings Regarding the Guidance Material's Suitability to the Content (Subject)

The participants were asked, *"What do you think about the developed guidance material's suitability to the content (subject)?"* All teachers are seen to think the developed material to be suitable to the content (subject). P5 stated "*It is suitable for the content. Because it covers all the learning outcomes.*"

Findings Concerning the Guidance Material's Adaptability to Different Subjects

The participants were asked, *"What do you think about the developed guidance material's adaptability to different subjects?"* All teachers were seen to answer the developed material to be adaptable to other subjects. P3 made a statement as "*applicable*".

Findings Related to the Missing or Improvable Points

The participants were asked, *"Are there any missing or improvable points in the developed guidance material? If so, what are they?"* Eight teachers (P1, P2, P3, P4, P6, P8, P9, P10) saw no shortcomings regarding the developed material, while two teachers found material improvable. In this sense, P5 expressed, "*It could have been designed as an out-of-class (but in-school) activity.*" P8 made a statement on this subject as "*There is no missing information point in the material*".

DISCUSSION & CONCLUSION

This study has concluded the orienteering-based guidance material developed on mitosis and meiosis cell division to be suitable to the students' level. This result parallels Avci's (2013) study that obtained the opinions of 9th- and 10th-grade students on the use of orienteering activities in geography lessons and reached very positive results in this regard. In addition, the current study has concluded orienteering activities to be suitable to the students' level as they enable creative thinking and brainstorming, contribute to meaningful learning, provide permanent learning, are understandable as an activity, are suitable for learning outcomes, easy to learn, and add visuality. Similarly, Avci (2013) concluded orienteering activities to increase interest in the lessons, teach how to use theoretical knowledge in daily life, and reinforce knowledge.

This study concluded that students can use orienteering activities. Parallel to this finding, Avci (2013) reached the conclusion that orienteering activities can be used in geography lessons. In addition, Imamoglu and Imamoglu (2018) concluded that using orienteering sport as an activity would be beneficial in classes for achieving learning outcomes in the secondary education curricula. The present study has concluded teachers to intend to use orienteering activities to determine readiness, teach the subject, evaluate the end of the unit, and repeat the unit.

This study concludes orienteering activities to be able to be used effectively in classroom management and to have positive contributions such as increasing communication, providing a fun classroom environment, and allowing students to discover; this situation will depend on classroom size, and the activities may also lead to disciplinary problems and confusion. In their study, Imamoglu and Imamoglu (2018) concluded students to be able to improve themselves in many ways, such as making decisions on their own and taking responsibility. Considering this result, students are believed will support the teacher in classroom management.

The study has found orienteering activities to have different methods and techniques than those teachers had previously used in terms of providing permanent learning and active participation; being remarkable, different, innovative, collaborative, competitive, more effective, and entertaining; increasing attitude and motivation; and raising awareness. Avci's (2013) study also concluded that students learn lessons by having fun and increasing awareness of the natural environment in which they live and that orienteering activities should be used as a teaching method in lessons. In this context, Avci (2013) concluded the activities to enable learning a subject by having fun and increasing awareness of the natural environment; therefore, orienteering activities should be used as a teaching method in lessons. In this respect, the views of teachers and students overlap with each other. Similarly, Yavuz Konokman et al. (2016) concluded in their study that elementary school prospective teachers' enjoyed designing innovative materials other than existing materials.

According to the participants, the developed material has been concluded to have advantages such as providing permanent learning and active participation, being collaborative, enabling quick thinking, and developing map-reading skills; it also has the disadvantage of being difficult to apply in crowded classrooms. According to the participants, the material developed provides permanent learning and active participation, being collaborative, providing quick thinking, improving map reading skills; It also has the disadvantage that it is difficult to implement in crowded classrooms. Atakurt et al. (2017) determined that orienteering trainings have a positive evaluation on the memory and attention of Europeans. Demir et al. (2022), on the other hand, state that the speed of orienteering events and their positive effects on visual memory. These results show parallelism with carrying out permanent learning from the existing results. Kara (2020), directed towards young children, was perceived to be effective in women's understanding of the concepts of place/direction. This result shows parallelism with the development of map reading skill.

The present study has concluded orienteering activities to contribute to teachers and almost all teachers to have stated wanting to receive training on orienteering. Moreover, the developed material has been concluded to increase students' interest in the lesson. This finding is in parallel with the conclusion that Avci (2013) obtained in his study that the students took great pleasure and enjoyed orienteering. The research has also concluded the orienteering-based guidance material developed on the subjects of mitosis and meiosis to usable in science lessons; it can facilitate the teaching of the subject; embody the subject; be remarkable and student-centered; provide permanent learning, collaborative learning and teaching with games; and will increase student motivation. In addition, it was determined in line with the opinions of the teachers that orienteering activities could be adapted to other subjects in science lessons. Likewise, Avci (2013) concluded orienteering as a sport to also be usable in different topics in geography courses. Therefore, the sport of orienteering is considered adaptable to many courses and subjects; in this way, it can be used as a method or technique for teaching a subject.

Different opinions have been concluded to exist about whether the recommended course duration is sufficient for conducting the activity developed in the current research. Considering that four participants found the time sufficient, four participants stated the duration to possibly vary based on class size, and two participants found the time insufficient, the recommended duration is considered able to be increased. This result is in parallel with the other studies. Cetgin (2021), as a result of the research, stated that one of the most critical factors of the orienteering game program is time wasting. Similarly, there are many international studies that show that the use of alternative teaching methods and techniques in the classroom environment causes time problems (Ceyhan et al., 2019; Cheng et al., 2019; Gursoy, 2021).

Lastly, the research has concluded that problems such as lack of materials or time, discipline issues, complexity, and bias may be encountered in conducting the activity. Avci (2013) concluded that applying orienteering in school playgrounds or gymnasiums would increase its applicability. Considering these findings together, the environment in which the activities will be carried out is thought should change.

As a result of this study, it is predicted that orienteering activities can be used in science lessons, ensure active participation and cooperation of students in the lesson, improve students' quick thinking and map reading skills, and be useful in affective care such as attitude. It may be beneficial to teachers and students in motivation and teaching-learning.

Recommendations

In light of its results, the study makes the following recommendations:

- This study aimed to develop an orienteering-based guidance material for the 7th-grade subject of mitosis and meiosis. Future studies can investigate the effect of using the guidance material developed on the 7th-grade topic of mitosis and meiosis in terms of students' academic achievement and attitudes.
- This research has discussed the 7th-grade subject of mitosis and meiosis. Future research can be carried out on different grades and classes.
- This research has used documents as the data collection tool. Future research can be supported by interviews and observations.
- During the process of developing the orienteering-based guidance material for the 7th-grade topic of mitosis and meiosis, interviews can also be made with students to address their misconceptions about the subject.
- In-service trainings can be organized for teachers on developing guidance materials and orienteering.
- In this study, only guide material was developed and teachers' opinions were consulted. In line with these predictions, this guide material was found to be applicable. In future studies, teachers and students can be consulted by applying the application.
- This study was conducted with 17 open-ended questions and 10 open-ended questions were asked. It is recommended to refer to the evaluation of 34 teachers who are at least twice as high in future studies.
- In the study, the opinions of teachers between the ages of 20-54 were consulted. In future studies, it is recommended to determine age groups at equal intervals.

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APPENDIX

Appendix 1. Guidance Material Instructions

Lesson	**Science**
Grade level	7
Topic/unit	**F.7.2.2.** Mitosis/**F.7.2.** Cell and Divisions
	F.7.2.3. Meiosis/**F.7.2.** Cell and Divisions
Learning objectives	**F.7.2.2.1.** Explain the importance of mitosis for living things.
	F.7.2.2.2. Explain that mitosis consists of different successive phases. (The names of the stages of mitosis are not given.)
	F.7.2.3.1. Explain the importance of meiosis for living things. (The stages of meiosis are given as Meiosis I and Meiosis II.)
	F.7.2.3.2. Shows how meiosis takes place in reproductive cells on the model. (Cell names are not mentioned during gamete formation. Only sperm and egg are stated.)
	F.7.2.3.3. Compares the differences between meiosis and mitosis. (While the differences between meiosis and mitosis are given, the differences in the division stages are not mentioned.)
Materials/ equipment	Orienteering map, Orienteering target (6 pieces) - Part 1
	Orienteering map, Orienteering target (11 pieces) - Part 2
	Orienteering map, Orienteering target (10pieces) - Part 3
Duration	40 min.
Activity name	Mitosis and Meiosis
Objectives	To enable students to learn the subjects of “mitosis and meiosis” by using "Orienteering techniques" in science course
	It is aimed that the students proceed towards the determined objectives by using the three different maps (mitosis stages, meiosis stages, the differences between mitosis and meiosis) given to them, and write down the stages of mitosis and meiosis according to the information given in these objectives and the differences of these divisions in the “checkbox” on the map correctly and in the correct order.
	While the students’ progress towards the targets set on the map, they will both have fun, attain permanent learning and meet the sport of orienteering with this educational game activity.
Place	In-class ***/ In-school***
Adaptation	Labyrinth, Grid
Implementation	First of all, the Orienteering map is drawn. The drawn map is reproduced and given to each student. Students are divided into teams of three. Students in each team are given individual maps. The first of these maps is about the stages of mitosis, the second is about the stages of meiosis, and the third is about the differences between mitosis and meiosis. The parkours created on the maps are planned as a "classical parkours" with 6, 11 and 10 targets. When the team members exit together with the teacher's command, for example, one member of a team will list the stages of mitosis, the other will list the stages of meiosis, and the other will correctly match the differences between mitosis and meiosis. Students progressing to the goals meet at the finish point.
Assessment	The team that reaches the target the fastest and in the correct way wins the first place.
Part 1 (F.7.2.2.1. and F.7.2.2.2.)	The information given on the map in this section relates to the stages of mitosis. Information cards of 10x5 cm, in which the characteristics of a certain stage of mitosis are given, are prepared in sufficient numbers by the teacher. In addition, at each target point there are many small cards with different stages of mitosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of a certain phase of mitosis are given and paste the appropriate phase into the "control box" on the map.
Part 2 (F.7.2.3.1. and F.7.2.3.2.)	The information given on the map in this section relates to the stages of meiosis. Information cards of 10x5 cm, in which the characteristics of a certain stage of meiosis are given, are prepared in sufficient numbers by the teacher. In addition, at each target point there are many small cards with different stages of meiosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of a certain stage of meiosis are given and paste the appropriate stage in the "control box" on the map.
Part 3 (F.7.2.3.3.)	The information given on the map in this part is about the differences between mitosis and meiosis. Information cards of 10x5 cm, in which the characteristics of mitosis and meiosis are given, are prepared in sufficient numbers by the teacher. Also, at each target point, there are two different little cards called mitosis and meiosis. While the students are progressing at their target points, they read the information on the information cards where the characteristics of mitosis and meiosis are given and paste the appropriate card into the "control box" on the map.

Appendix 2.

Stop Number: 26

- The cell prepares to divide before undergoing mitosis.
- DNA replicates, and double its number.
- The number of organelles increases.
- Energy production and consumption accelerate.

Stop Number: 23

- Karyokinesis begins.
- Chromosomes are formed.
- Chromosomes consist of structures with exactly the same genetic structure, called sister chromatids, which are formed as a result of DNA replication.
- Chromosomes are attached to the spindle fibers formed during this time.

Stop Number: 20

- Chromosomes get aligned at the center of the cell.

Stop Number: 11

- A cleavage furrow begins to form in the middle of the cell.
- Sister chromatids are pulled to different poles by spindle fibers.

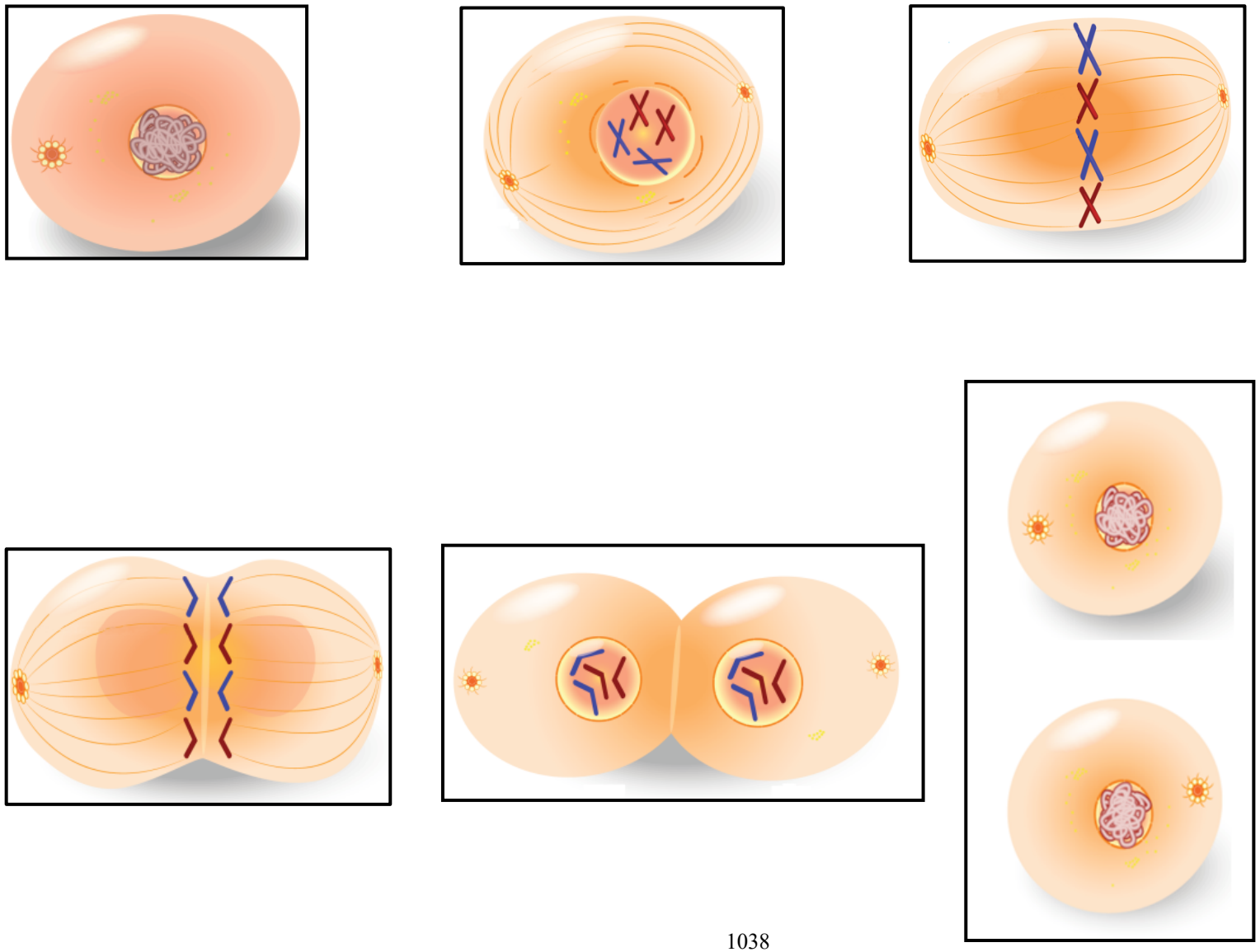
Stop Number: 5

- Equal distribution of chromosomes to the cells is completed.
- Since each of the sister chromatids passes into separate cells, the genetic structures of the new cells formed are exactly the same.

Stop Number: 2

- Two new cells are formed with the completion of the cleavage furrow.
- Since the amount of DNA doubles before division and then halves again, the DNA amount and chromosome number of the cells will be the same as the original mother cell.

Appendix 3.



Appendix 4.

Stop Number: 25

- DNA replication occurs.
- The number of organelles increases.

Stop Number: 21

- Spindle threads are formed.
- Exchange of parts occurs between homologous chromosomes.

Stop Number: 22

- Homologous chromosomes get aligned at the center of the cell.

Stop Number: 19

- Homologous chromosomes are pulled to opposite poles by spindle fibers.

Stop Number: 16

- A cleavage furrow begins to form in the middle of the cell.
- The number of chromosomes is reduced to half.

Stop Number: 14

- Two cells are formed, genetically different from each other and with half the number of chromosomes of mother cell.

Stop Number: 13

- The nuclear membrane disappears.
- Chromosomes are attached to spindle fibers.

Stop Number: 12

- Chromosomes get aligned at the center of the cell.

Stop Number: 7

- Sister chromatids are pulled to different poles by spindle fibers.

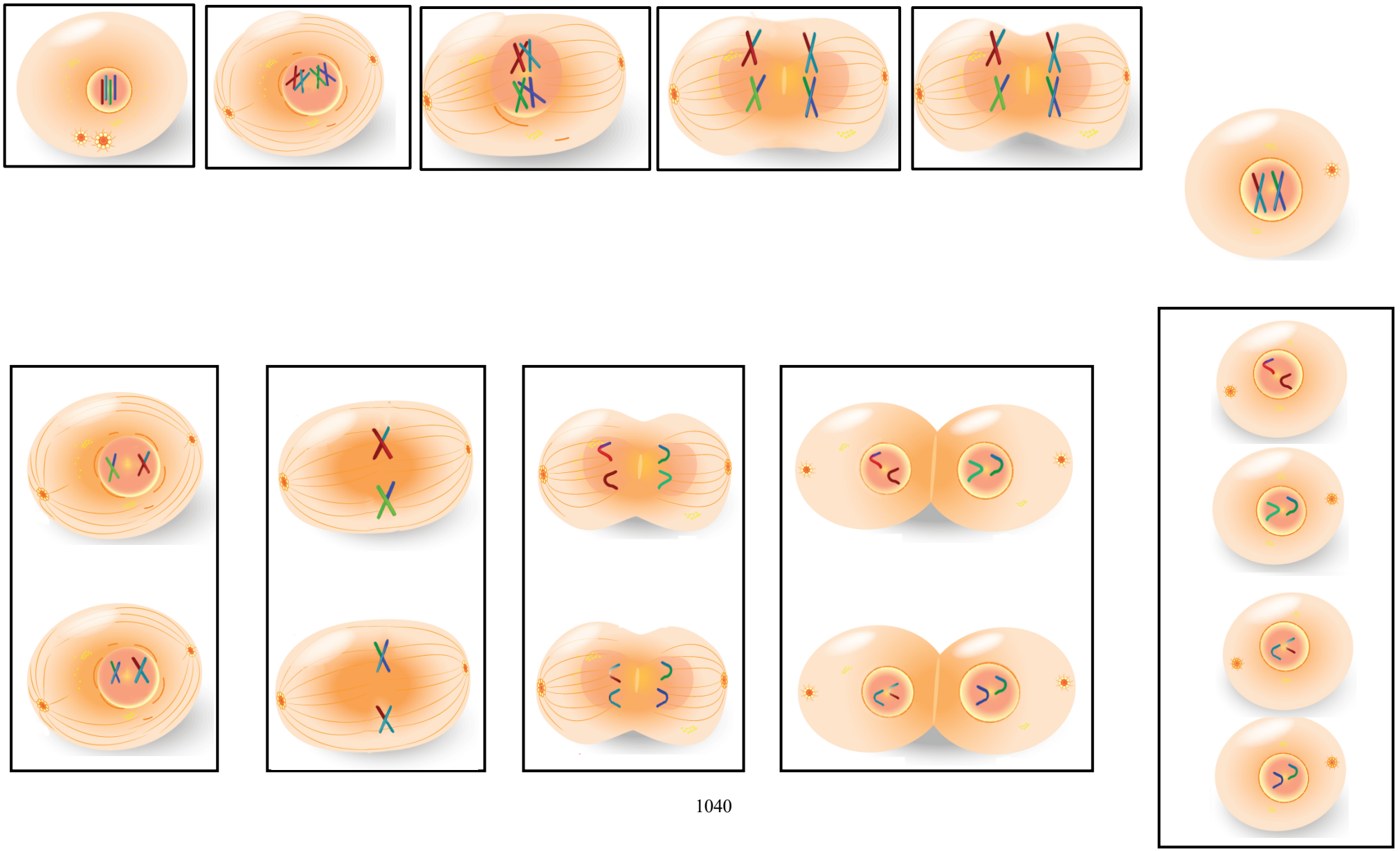
Stop Number: 3

- Equal distribution of chromosomes to the cells is completed.

Stop Number: 4

- Four new cells are formed with the completion of the cleavage furrow.

Appendix 5.



Appendix 6.

Stop Number: 27

- It is seen in body cells.

Stop Number: 28

- It provides the formation of reproductive cells.

Stop Number: 24

- Chromosome number is halved.

MITOSIS

Stop Number: 17

- The genetic structure of the cells formed as a result of division is different from the mother cell.

Stop Number: 15

- It provides reproduction in single-celled organisms, and growth, development and repair of wounds in multi-celled organisms.

Stop Number: 9

- Chromosome number does not change.

MEIOSIS

Stop Number: 8

- Four cells are formed as a result of division.

Stop Number: 6

- It is seen only in reproductive mother cells.

Stop Number: 1

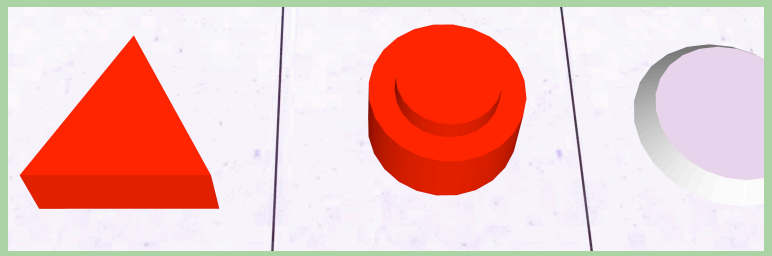
- The structure of the cells formed as a result of division is the same as the mother cell.

Stop Number: 10

- As a result of division, two cells are formed.

Appendix 7.

INSTRUCTIONS



START	END	STOP

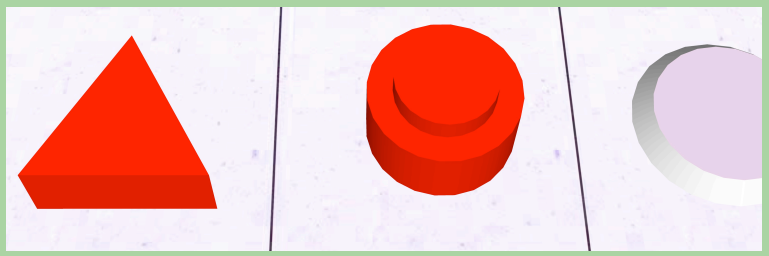
Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

26	**23**	**20**	**11**	**5**	**2**

Appendix 8.

INSTRUCTIONS



START | END | STOP

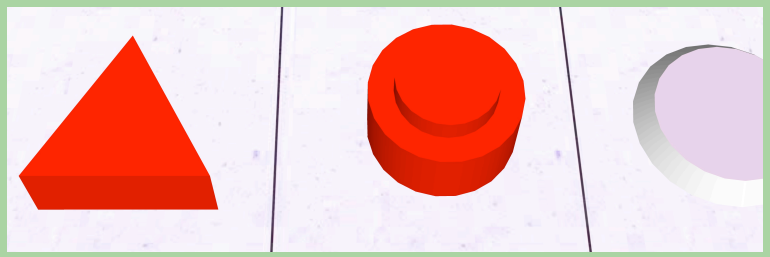
Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

25	21	22	19	16	14
13	12	7	3	4	

Appendix 9.

INSTRUCTIONS



START | END | STOP

Please pay attention to the figures above and find the passwords at the stops from the start point to the end point. Put these passwords you find in the control box. Let's see what you will come across on this road?

CONTROL BOX

27	28	24	18	17	15
9	8	6	1		

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Constructivist Learning Environment: A Perfect Mediator for The Relationship of Students' Multiple Intelligences with Attitudes Towards and Achievement in STEM

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Abstract

In STEM disciplines, it is crucial to design research studies clarifying the relationships between academic performance-related constructs and academic performance. This study aims at exploring whether middle school students' perceptions of constructivist learning environment (P-CLE) mediate the relationship between their perceptions of multiple intelligences (P-MI) and their attitude towards STEM disciplines (AtSTEM) and their achievement in STEM disciplines (AchSTEM). Because the relationships among middle school students' P-CLE, P-MI, and AtSTEM and AchSTEM are under investigation, this study is a correlational study. The sample consisted of 579 students from randomly selected 10 middle schools in Kayapınar, a district of Diyarbakır, Turkiye. The students' GPA scores in STEM-related courses were used to represent their achievement in STEM disciplines. In addition, the Attitude towards STEM Survey, Multiple Intelligences Inventory, and Constructivist Learning Environment Survey were used for the data collection. Lavaan, an R package, was used to conduct structural equation modeling for mediation analysis. The mediation analysis yielded that the P-CLE was a perfect mediator for the relationship between the P-MI and AtSTEM and AchSTEM. In consequence, this study emphasizes the importance of providing constructivist learning environments in STEM classes and encouraging students to think of intelligence as something malleable.

Keywords: STEM, achievement, multiple intelligences, constructivist learning environment.

Yapılandırmacı Öğrenme Ortamı: Öğrencilerin Çoklu Zekâ Alanlarının FeTeMM'e Yönelik Tutum ve Başarılarıyla İlişkisinde Mükemmel Bir Aracı

Öz

FeTeMM disiplinlerinde, akademik performansla ilgili yapılar ile akademik performans arasındaki ilişkileri açıklığa kavuşturan araştırmaların tasarlanması önem taşımaktadır. Bu çalışmanın amacı, ortaokul öğrencilerinin yapılandırmacı öğrenme ortamı algılarının (YÖOA), çoklu zekâ algıları (ÇZA) ile FeTeMM disiplinlerine yönelik tutum ve başarıları (FeTeMM-T, FeTeMM-B) arasındaki ilişkiye aracılık edip etmediğini araştırmaktır. Ortaokul öğrencilerinin çoklu zeka algıları, yapılandırmacı öğrenme ortamı algıları ve FeTeMM disiplinlerine yönelik tutum ve başarıları arasındaki ilişkiler araştırılmakta olduğundan, bu çalışma korelasyonel bir çalışmadır. Örneklem, Diyarbakır'ın Kayapınar ilçesinde rastgele seçilen 10 ortaokuldan 579 öğrenciden oluşmaktadır. Öğrencilerin FeTeMM ile ilgili derslerdeki not ortalamaları, FeTeMM disiplinlerindeki başarılarını temsil etmek için kullanılmıştır. Ayrıca, veri toplamak için FeTeMM'e Yönelik Tutum Anketi, Çoklu Zeka Envanteri ve Yapılandırmacı Öğrenme Ortamı Anketi kullanılmıştır. Aracılık analizi için yapısal eşitlik modellemesi yapmak üzere bir R paketi olan Lavaan kullanılmıştır. Arabuluculuk analizi, YÖOA'nın ÇZA ve FeTeMM-T ve FeTeMM-B arasındaki ilişki için mükemmel bir aracı olduğunu ortaya koymuştur. Sonuç olarak, bu çalışma FeTeMM sınıflarında yapılandırmacı öğrenme ortamları sağlamanın ve öğrencileri zekâyı şekillendirilebilir bir şey olarak düşünmeye teşvik etmenin önemini vurgulamaktadır.

Anahtar kelimeler: FeTeMM, başarı, çoklu zekâ, yapılandırmacı öğrenme ortamı.

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INTRODUCTION

Science, Technology, Engineering, and Mathematics (STEM) movement, which first emerged in the 1990s in the United States (Martín-Páez et al., 2019), has started to become visible in the post-secondary education in the last fifteen years as well (Talanquer, 2014). Concurrently, the STEM movement began to spread all over the world after the success of establishing a "degree in STEM education" at the Virginia Tech University in 2005 (Martín-Páez et al., 2019). Apparently, there are some inter-related reasons for why STEM education has got such an international popularity. It is possible to categorize them as: (1) deficient competence in STEM disciplines (Martín-Páez et al., 2019), (2) lack of knowledge transfer (Martín-Páez et al., 2019; Roberts, 2012; Talanquer, 2014), and (3) growing demand for well-educated human resource in STEM disciplines with twenty-first century skills (Bybee, 2010; Corlu et al., 2014; Kelley & Knowles, 2016; Martín-Páez et al., 2019; Talanquer, 2014).

In spite of such a popularity, a cohesive definition or understanding for STEM education could not be presented (Kelley & Knowles, 2016; Martín-Páez et al., 2019). There are differing conceptions, from the fact that STEM education can be implemented in a single discipline to the fact that all disciplines must be integrated consistently. For most instructors and researchers, it means science and mathematics (Bybee, 2010; Corlu et al., 2014). For others, technology and engineering are so greatly in our daily life that it is not possible to make sense of everyday life contexts or socially and culturally relevant STEM contexts without approaching all those disciplines as whole entity - integrated STEM approach (Bybee, 2010; Kelley & Knowles, 2016; Martín-Páez et al., 2019; Roberts, 2012; Stohlmann et al., 2012; Talanquer, 2014). Moreover, the total or the whole entity is much more than the sum of the contents of those disciplines (Zollman, 2012 as cited in (Martín-Páez et al., 2019)).

As well as the non-cohesive conceptualization of STEM education, there is no a cohesive conceptualization about the implementation of integrated STEM education, either. The integrations are based on different combinations. Some researchers suggest "engineering" as a hinge to bring other disciplines together (i.e. (Brophy, Klein, Portsmore, & Rogers, 2008)) while some others suggest "mathematics" as a bridge for the integration (Kertil & Gurel, 2016). On the other hand, a coherent conceptualization about the teaching and learning methodologies accompanying the STEM education may be presented. Informal teaching, inquiry teaching, project- and problem-based teachings, which are "constructivist" or "student-centered" teaching methods in nature, have been supposed to contribute to STEM integrations (Martín-Páez et al., 2019; Roberts, 2012; Smith et al., 2009; Struyf et al., 2019).

Besides, there is persuasive evidence that constructivist learning approaches contribute to students' cognitive and attitudinal constructs better than the traditional approaches. Constructivist learning approach, which is defined as forming of new knowledge on the existing knowledge that individuals possess based on their experiences, has attracted attention in the twenty-first century in the globe (Fosnot, 2013; Tan, 2017). According to the constructivist view, knowledge is not something discovered. In other words, it is not something out there, in the outer world, to acquire (Gordon). Meanwhile, it is not something transmitted, or it is not formed in the brain as a sponge absorbs water (Roberts, 2012). It is constructed. In this context, as educators, our mission must be providing students with environments helping them construct their knowledge on their own. Constructivist learning environments, which are imaginative and integrative atmospheres, are key aspect of STEM education, and particularly, problem-, project-, context-, and inquiry-based learning have been proved to support the STEM education. Relation of the constructivist learning environments to STEM learning via positive attitude towards science is so clear that it is unavoidable to take it into account (Martín-Páez et al., 2019; Smith et al., 2009; Struyf et al., 2019).

In addition to constructivist learning environment, socio-psychological issues such as students' academic achievement related knowledge, beliefs, and perceptions have been shown to be positively related to academic performance in science and other disciplines. By the way, it is obviously crucial to make sense of how those relationships are in STEM disciplines (Talanquer, 2014). One of socio-psychological issues that possess an extensive literature in not only science education but also other disciplines is students' perceptions of multiple intelligences (P-MI).

Multiple intelligence theory was developed by Gardner (Armstrong, 2000) as a positive reaction against the limitations of intelligence questionnaires. He criticized the validity of such intelligence-scoring questionnaires through which individuals are asked for carrying out some unfamiliar tasks out of their natural learning environments. According to him, labeling individuals with an intelligence score would be unfair to combinations of multiple intelligences they possess and he at last proposed eight intelligences by categorizing capabilities people possess: (1) linguistic intelligence – the capability to use words effectively, whether orally or in writing, (2) logical-mathematical intelligence – the capability to use numbers effectively, (3) spatial intelligence – the capability to

make sense of and use the virtual-spatial world accurately, (4) bodily-kinesthetic intelligence – the capability to use the whole or part of body to express ideas and feelings, (5) musical intelligence – the capability to perceive, transform, discriminate, and express musical form, (6) interpersonal intelligence – the capability to perceive and make distinction in the moods, intentions, motivations, and feelings of other people, (7) intrapersonal intelligence – the capability to use self-knowledge for acting adaptively, and (8) naturalist intelligence – the capability to recognize and classify of the numerous species in the environment (Armstrong, 2000).

That contemporary view of intelligence inspired many STEM education researchers like other researchers. As a result, it yielded an extensive literature, mainly in two categories: (1) experimental research aiming at exploring the effects of multiple intelligence-based interventions, and (2) associational research aiming at exploring the relation of P-MI to some educational constructs. The research on the effect of implementations based on the multiple intelligence theory has shown significant contribution to academic attitude to and achievement in STEM classes (Aina, 2018; Aydin, 2019; Baş, 2016; Batdı, 2017; Douglas et al., 2008; Gurcay & Ferah, 2017; Nasri et al., 2021; Okur & Kural, 2021; Pratiwi et al., 2018; Sánchez-Martín et al., 2017; Theobald et al., 2020). Similarly, research on association between P-MI and academic performance in STEM disciplines has also yielded in significant relationships (Ahvan & Pour, 2016; Baran & Maskan, 2011; Chan, 2006; Lillbacka, 2013; Pallrand & Seeber, 1984; Snyder, 1999; Träff et al., 2019)

Motivation and Purpose of the Study

A brief summary of the theoretical framework just aforementioned in the previous section and shedding light to this study can be summarized as follows:

1.There is huge amount of interest in student attitude towards and success in STEM fields in the related literature due to some reasons, such as, deficient competence in STEM disciplines, lack of knowledge transfer, and growing demand for well-educated human resource in STEM disciplines.

2.The related literature indicates that the teaching methods providing constructivist learning environments, such as, informal teaching, inquiry teaching, or problem-based learning, contribute to STEM education by means of positive student attitude.

3.Students' P-MI is positively related to the success in STEM disciplines.

In order to contribute to advances in STEM education, it is quite crucial to design research studies clarifying the relationships between academic performance related constructs and academic performance in STEM disciplines (Talanquer, 2014). In line with that recommendation and the related literature review, the main purpose of this study is to clarify the relations of middle school students' perceptions of multiple intelligences (P-MI) and constructivist learning environment (P-CLE) to their attitude towards STEM disciplines (AtSTEM) and achievement in STEM related disciplines (AchSTEM). In particular, the purpose is to investigate whether middle school students' P-MI mediates the relation of their P-CLE to their AtSTEM and AchSTEM, or vice versa. From this perspective, the study is indeed a mediation analysis. The related literature has already reported the significant and positive relations of the P-MI and the P-CLE to the AtSTEM and AchSTEM. What this study clarifies is that which one of those constructs mediates the relationship between the other construct and the AtSTEM and the AchSTEM. Furthermore, the study also reveals concretely what magnitude are the relationships among those educational constructs. Accordingly, the hypothesized model tested in this study is given in Figure 1.

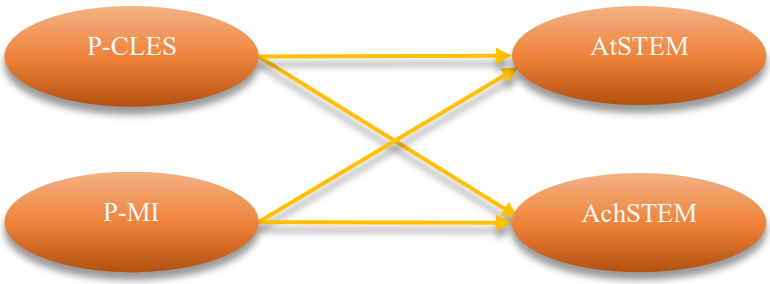

Figure 1. *The hypothesized model (P-CLE: Perceptions of constructivist learning environment; P-MI: Perceptions of multiple intelligences; AtSTEM: Attitude towards in STEM related disciplines; AchSTEM: Achievement in STEM related disciplines)*

Research Questions

This study aims at exploring whether middle school students' perceptions of multiple intelligences mediates the relationship between their perceptions of constructivist learning environment and their attitude towards and achievement in STEM related disciplines, or vice versa. In accordance, the specific research questions are as the following:

1.Is the individual relationship between middle school students' perceptions of multiple intelligences and their attitude towards and achievement in STEM related disciplines significant, if so, what is the magnitude of this relationship?

2.Is the individual relationship between middle school students' perceptions of constructivist learning environment and their attitude towards and achievement in STEM related disciplines significant, if so, what is the magnitude of this relationship?

3.Does middle school students' perceptions of multiple intelligences mediate the relationship between their perceptions of constructivist learning environment and their attitude towards and achievement in STEM related disciplines significant, or vice versa, and what are the magnitudes of these relationships?

Assumptions

The assumptions of the study are listed as follows:

1.The students' grade point averages (GPA) in STEM-related courses, which provide data for this study, are reliable indicators of their achievement in STEM.

2.The students gave candid and independent responses to the instruments administered in this study.

3.The students' scores on the Attitude towards STEM Survey represent their attitude towards STEM and 21st century skills.

4.The students' scores on the Multiple Intelligences Inventory represent their P-MI they possess.

5.The students' scores on the Constructivist Learning Environment Survey represent their perceptions about the level of constructivist learning environment provided to them.

METHOD

Because of the relationships among middle school students' P-MI, P-CLE, and AtSTEM and AchSTEM, which are continuous variables, are under investigation, this study is a correlational study, an example of associational research (Fraenkel et al., 2012, pp. 330-364).

Sample

All seventh-grade students, who are 12 or 13 years old, in Diyarbakır, constitute the study's target population. However, the accessible population is all the seventh-grade students in Kayapınar, a district of Diyarbakır, Turkiye. The sample is consisted of 579 students from randomly selected 10 middle schools. In other words, random selection of intact classes drawn the sample of this study (Fraenkel et al., 2012, pp. 90-109). The percentages of females and males are 59 and 41, respectively. In conclusion, the students could be assumed to represent many traits of the population, such as socio-economic status, gender, or other individual differences because the schools were randomly selected from the population.

Data Collection

STEM-related GPA scores of the students drawing the sample of the study were used as the observable variables to represent their achievement in STEM disciplines. Therefore, teacher-made assessment tools on the STEM related courses, which are explained in the next section, constitute an important part of the instruments that provided data for this study. On the other hand, the other instruments are Attitude towards STEM Survey, Multiple Intelligences Inventory, and Constructivist Learning Environment Survey.

GPA scores in STEM related courses

In this study, one of the educational constructs as a latent variable is middle school students' achievement in STEM disciplines. The observable variables related to this latent variable are the students' GPA scores in STEM-related courses. These courses are natural sciences, mathematics, information technologies and software, visual arts, and technology and design. The courses were assumed to be STEM-related courses according to their specific goals and content given to the students reported in the middle school curricula. Table 1 presents the specific goals of the STEM related courses which can be attributed to the 21st century skills based on relevant curricula developed by Ministry of National Education (MoNE).

Table 1. STEM Related Courses' Specific Goals Attributed to 21st Century Skills from the Related Curricula

Course Name	Related Specific Objectives
Natural Sciences	• To make students acquire fundamental knowledge on science and technology applications. • To make students be aware of interrelationships among individuals, environment, and society. • To enable students to use scientific knowledge and skills to overcome real-life problems. • To make students be aware of natural sciences related careers and to make them acquire entrepreneurial skills (MoNE, 2018b).
Mathematics	• To make students be able understand mathematical concepts and use them in real-life experiences. • To help students use mathematical terminology properly to communicate mathematical thinking. • To help students make sense of the relationships between human being and objects, and the relationships between objects and objects by means of the meaning and language of mathematics. • To make students articulate the concepts with multiple representations. • To make students develop skills about research and knowledge accumulation. • To make students realize the relationship of mathematics to arts and esthetics (MoNE, 2018d).
Information Technologies and Software	• To help students use information technologies properly and effectively. • To make students construct an overall understanding and technical accumulation in Computer Sciences. • To help students monitor and evaluate scientific reasoning. • To help students explore learning facilities on internet. • To make students execute studies in product design and management. • To help students develop innovative and exclusive projects to overcome real-life problems encountered. • To make students be aware of life-long learning (MoNE, 2018a).
Visual Arts	• To make students acquire fundamental knowledge, skills, and understanding in Visual Arts. • To make students follow current culture-and-art objects consciously. • To make students communicate effectively by utilizing knowledge, skills, materials, technique, and technology in visual arts in safety. • To help students integrate visual arts with other disciplines. • To make students be aware of visual arts related careers (MoNE, 2018c).
Technology and Design	• To make students acquire fundamental knowledge on development of technology. • To make students acquire fundamental knowledge on design process. • To make students use technology and design related knowledge and skills to overcome real-life problems. • To help students understand professional designers' problem identification and solution approaches. • To make students realize interrelationships among individuals, environment, society, and technology. • To help students develop skills of problem identification and solution (minds-on), and implementation (hands-on). • To make students be aware of technology and design related careers (MoNE, 2015).

Attitude towards STEM Survey

The Attitude towards STEM Survey (AtSTEM) was developed by Friday Institute for Educational Innovation (2012) with 37 5-point Likert type items (from Strongly agree to strongly disagree) and four dimensions (science, mathematics, engineering and technology, and 21st century). The dimensions include items to assess student attitudes to science, mathematics, engineering, technology, and 21st century skills (i.e., math is important for my life, I am sure of myself when I do science, I like to imagine creating new products, I am confident I can act responsibly). Friday Institute for Educational Innovation (2012) reports the AtSTEM as valid scale to collect reliable data with very high alpha reliability coefficients for each dimension, ranging from .89 to .92. Luo et al. (2019) conducted research supporting the validity of the scale from subtle aspects. They provided evidence not only related to internal structure validity but also related to criterion-related validity. Their measurement invariance results yielded that the AtSTEM can be utilized reliably in studies comparing groups or longitudinal research.

The Turkish version of the AtSTEM was adapted by Özcan and Koca (2019) in six phases: translation, reverse translation, language validation, pilot administration, final version, and main administration. They also reported the AtSTEM scores as a valid and reliable assessment of students' attitudes towards STEM with similar alpha reliability coefficients ranging from .89 to .91 for each dimension. In this study, the alpha reliability for the whole scale was .91 while they were ranging from .86 to .88 for each dimension. As a result, these findings support that the AtSTEM seems to be able to yield reliable attitude scores towards STEM.

Multiple Intelligences Inventory

The Multiple Intelligences Inventory (MII) was developed by Armstrong (2000) with eight dimensions and 80 items. Each dimension is associated with eight multiple intelligences: linguistic (i.e., Books are very important to me.), logical-mathematical (i.e., I can easily compute numbers in my head), spatial (i.e., I like to draw or doodle),

bodily-kinesthetic (i.e., I find it difficult to sit still for long periods of time), musical (i.e., I have a pleasant singing voice), interpersonal (i.e., I have at least three close friends), intrapersonal (i.e., I consider myself to be strong willed or independent minded), and naturalist (i.e., I thrive on having animals around the house) to assess individuals' P-MI. The items in each dimension aims at assessing performance in some kind of tasks, activities, and experiences in the related intelligences. However, the tasks, activities, and experiences in these dimensions are quite limited with respect to the real spectrum of intelligence related abilities. Therefore, Armstrong (2000) emphasizes that this inventory could only partially assess multiple intelligences, too as any test cannot totally assess a person's intelligences. The scale was adapted to Turkish by Oral (2001) as a 5-point Likert scale (fits me very well, fits me well, fits me moderately, fits me a little, fits me little) and he reported the Turkish version provide with reliable assessment of multiple intelligences. The split-half reliability coefficient was calculated as .79 for the whole scale. The reliability coefficients for each dimension were calculated as the correlations between each dimension and the total scores, and they were ranging from .62 to .73. In this study, the Croanbach alpha reliability coefficients were calculated for evaluating whether reliable scores were collected. The alpha reliability coefficient for the whole scale was .94 while they were ranging from .55 to .74 for each dimension. As expected, the reliability coefficients for the dimensions may be smaller than .70, the acceptable critical value, because number of the items are limited with respect to the whole scale (Pallant, 2007). As a result, the MII scale could successfully yielded reliable scores of students' multiple intelligences.

Constructivist Learning Environment Survey

The Constructivist Learning Environment Survey (CLES) was developed by Taylor et al. (1997) to monitor what level of constructivist learning environment students are provided with in science courses so that teachers could monitor their development of constructivist approaches to teaching school science and mathematics. Following fine-grained analysis conducted for testing the validity and reliability of the scale, the CLES is a 30-item scale with 5-point Likert type frequency responses scale which involves the categories: almost always (5 points), often (4 points), sometimes (3 points), seldom (2 points), and almost never (1 points). The CLES has got five dimensions: personal relevance (i.e., I learn about the world outside of school), uncertainty (i.e., I learn that mathematics cannot provide perfect answers.), critical voice (i.e., It's OK to ask the teacher "why do we have to learn this?"), shared control (i.e., I help the teacher to plan what I'm going to learn.), and student negotiation (i.e., I get the chance to talk to other students.). The alpha reliability coefficients for each dimension, the researchers calculated, were greatly exceeding .70 apart from the dimension "uncertainty". In spite of the smallest reliability coefficient, .72, it was clearly indicated that the CLES could yield reasonably acceptable assessment of the level of constructivist learning environment the students were provided. Küçüközer et al. (2012) adapted the CLES into Turkish as a 25-item survey as a result of explanatory and confirmatory factor analysis, and the collected data demonstrated a good fit with the structure of the scale. The alpha reliability of the scale was calculated as .85 which means the CLES scores are quite reliable.

Procedure

After obtaining ethical and official permissions from the relevant ethics committee and the Directorate of National Education, booklets including all the instruments were administered to the participants under the supervision of one of the researchers. The students' GPA in natural sciences, mathematics, technology and design, visual arts, and information technologies and software courses in their last transcript received one semester ago were also requested in the booklet in order to represent their achievement in STEM. It took two lesson hours with a 15-minute break for the students to complete the booklet. Following the data collection, IBM SPSS Statistics (2016) was used for data entry, cleaning data, required computations, and descriptive analysis. Finally, lavaan – latent variable analysis (Version 0.5), an R package for structural equation modelling, (Rosseel, 2012) was used for the structural equation analysis.

Data Analysis

In accordance with the main purpose, whether middle school students' P-CLE mediated the relationship between their P-MI and their AtSTEM and AchSTEM was analyzed in this study. Mediation analysis took place in three steps: (1) whether relation of the independent variable to the mediator was significant, (2) whether relation of the independent variable to the dependent variable was significant, and (3) whether relations of both the independent variable and the mediator to the dependent variable were significant, were tested as Baron and Kenny (1986) suggested. If the relationships in the first two steps, and the relation of the mediator to the dependent variable in the third step are significant, then mediation is said to be established. As well as the significant relationship between the mediator and the dependent variable, if the significant relationship in the second step

between the independent variable and the dependent variable disappears in the third step, the mediation is called perfect mediation (Baron & Kenny, 1986).

As aforementioned, an R package, lavaan, was used for the mediation analysis. Besides, maximum likelihood estimation and covariance matrix were used in the analysis. Whether the data collected demonstrated a good fit with the models tested was evaluated using several multiple indices; such as goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSE) (Schreiber et al., 2006). According to Schreiber et al. (2006), GFI and AGFI are expected to be larger than .95 while SRMR and RMSEA are expected to be less than .08 and .06, respectively, thus claiming a good fit between the models tested and the data collected. Moreover, the boundary values for standardized regression coefficients reported by Kline (2005) were used in order to make sense of the magnitudes of the relationships in the tested models. Accordingly, standardized regression coefficients less than .10 are small, coefficients around .30 are medium, and coefficients above .50 are large effect sizes.

Variables

The latent and observable variables used in this study with the variable names used in the statistical analysis are given in Table 2. All the variables are continuous in nature and more information about their assessment is given in the "instruments" section.

Table 2. The Latent and Observable Variables

Latent Variables	Observable Variables	Variable names of the variables in the statistical analysis
The Perception of Constructivist Learning Environment of the Students (CLES)*	Personal Relevance	Relev
	Uncertainty	Uncer
	Critical Voice	CriVoi
	Shared Control	ShrdCo
	Student Negotiation	Negot
The Perception of Multiple Intelligences of the Students (MII)*	Linguistic Intelligence	Ling
	Logical-Mathematical Intelligence	Logi
	Spatial Intelligence	Spat
	Musical Intelligence	Music
	Naturalist Intelligence	Natu
	Bodily-Kinesthetic Intelligence	Body
	Interpersonal Intelligence	Inter
	Intrapersonal Intelligence	Intra
Attitude towards STEM of the Students (AtSTEM)*	Attitude to mathematics	AtMat
	Attitude to science	AtSci
	Attitude to engineering and technology	AtEng
	Attitude to 21th century skills	At21
STEM related courses' GPA scores (AchSTEM)*	Science	Scie
	Mathematics	Math
	Information Technology	InfT
	Technology Design	TechD
	Visual Art	visual

*The letters in the parenthesis next to the latent variables are names of the variables in the statistical analysis.

Power Analysis

In this section, the minimum sample size for conducting the structural equation modelling, or for observing statistically significant regression coefficients when the null hypothesis is really false is evaluated. Although there are no exact rules for the minimum sample size in structural equation modelling, sample sizes smaller than 200s are not acceptable as a general rule (Barrett, 2007). A more specific rule for minimum sample size of one sample structural equation modelling analysis was reported by Schreiber et al. (2006) and they stated that 10 per estimated parameters seems to be a commonly accepted ratio. Accordingly, in this one-sample study, the final tested model includes 27 regression coefficients, 22 variances, and 6 covariances. Thus, there are 55 estimated parameters in total. The sample size is 579 and consequently an acceptable ratio of 10.53 participants per estimated parameters is the case for this study. In conclusion, the sample size of the study seems fairly enough for conducting a powerful structural equation modelling analysis.

Research Ethics

This study was approved by the Social and Human Sciences Research Ethics Committee, and the authors declare that there are no conflicts of interest of any kind.

FINDINGS

Assumptions and Descriptive Statistics

The assumptions for conducting structural equation modelling analysis are basically about sample size, normality, outliers, linearity, multicollinearity and singularity (Pallant, 2005; Tabachnick & Fidell, 2007). The sample size required for the analysis is explained in the previous section and it can be concluded that the assumption relevant to the sample size is not violated. In order to check the normality assumptions, the Q-Q plots were analyzed for each observed variable. The skewness and kurtosis values presented in Table 3 were also used to check the normality assumptions. Except from Information Technologies, Technology Design and Visual Arts, all the observed variables were normally distributed. The observed variables violating the normality assumption are the students' GPA scores in these courses, and it can be concluded that the GPA scores are stacked at high scores for these courses because the distributions are negatively skewed and the kurtosis values are quite large.

In order to check if there were outliers in the data, the boxplots were evaluated for each variable. However, as Pallant (2005) explains, the box plots were accompanied by five percent trimmed mean scores to evaluate possible outliers. The mean and five percent trimmed mean scores in the table appear fairly comparable to each other for each variable compared to the standard deviations. Therefore, it was concluded that there were no outliers in the data. The minimum and maximum values in the table indicates that there was no error in the data entry. Cronbach's alpha reliability coefficients for each observed variable appear generally acceptable. However, there are a few alpha values less than .70 attributable to small number of items. As Briggs and Cheek (1986) explains, mean inter item correlations (MIIC) may be used in such cases and an optimal MIIC value should be between .20 and .40. Although there are some MIIC values less than .20 in Table 3, the alpha values may be considered acceptable for these variables measured with small number of items.

Table 3. Descriptive Statistics and Cronbach's Alpha Coefficients of Observable Variables

Observed variable	n	M	5% trimmed M	SD	Minimum	Maximum	Skewness	Kurtosis	Cronbach's α	MIIC
1. Personal Relevance	579	3.39	3.32	.85	1.00	5.00	-.26	-.36	.69	.31
2. Uncertainty	579	3.63	3.67	.95	1.00	5.00	-.50	-.27	.79	.42
3. Critical Voice	579	3.04	3.05	1.05	1.00	5.00	.04	-.65	.70	.36
4. Shared Control	579	2.90	2.89	1.09	1.00	5.00	.11	-.45	.84	.48
5. Student Negotiation	579	3.61	3.67	1.03	1.00	5.00	-.47	-.43	.84	.50
6. Linguistic Intelligence	579	3.51	3.53	.67	1.20	5.00	-.18	-.18	.65	.16
7. Logical-Mathemat. Intelligen.	579	3.61	3.62	.71	1.60	5.00	-.17	-.42	.74	.21
8. Spatial Intelligence	579	3.53	3.54	.67	1.40	5.00	-.13	-.11	.60	.17
9. Musical Intelligence	579	3.35	3.37	.71	1.00	5.00	-.28	-.23	.65	.16
10. Naturalist Intelligence	579	3.55	3.56	.66	1.60	5.00	-.10	-.33	.65	.16
11. Bodily-Kinesthetic Intellige.	579	3.57	3.58	.67	1.00	5.00	-.27	-.25	.65	.16
12.Interpersonal Intelligence	579	3.44	3.44	.65	1.40	5.00	-.03	-.47	.55	.13
13. Intrapersonal Intelligence	579	3.39	3.39	.66	1.60	5.00	-.11	-.14	.59	.12
14. Attitude to mathematics	579	3.07	3.09	.54	1.00	5.00	-.38	1.08	.74	.27
15. Attitude to science	579	3.51	3.55	.77	1.00	5.00	-.61	.32	.85	.39
16. Attitude to engineer. and tech.	579	3.58	3.62	.95	1.00	5.00	-.57	-.18	.88	.43
17. Attitude to 21th century skills	579	3.70	3.76	.91	1.00	5.00	-.85	.43	.90	.47
18. Science	579	2.24	2.28	.76	0.0	5.0	-.61	.08	NA	NA
19. Mathematics	579	1.94	1.99	.98	0.0	3.0	-.57	-.73	NA	NA
20.Information Technology	579	2.75	2.83	.53	0.0	3.0	-2.43	6.27	NA	NA
21. Technology Design	579	2.78	2.87	.52	0.0	3.0	-2.76	7.82	NA	NA
22. Visual Art	579	2.83	2.91	.48	0.0	5.0	-3.20	13.82	NA	NA

MIIC = mean interitem correlation

In Table 4, the correlations among all the variables are given. The shadowed cells are intra-correlations among the dimensions of a scale while the other cells are inter-correlations between dimensions of a scale and the other dimensions. For the CLES scale, the intra-correlations are small in size, with the exception of moderate correlation between "personal relevance" and "uncertainty". The largest intra-correlations appear on the MII scale. Almost all of them are medium size. On the other hand, the intra-correlations for the AtSTEM and AchSTEM scales are usually of small size. For the AtSTEM scale, the intra-correlations among attitude towards science, attitude towards engineering and technology, and attitude towards 21st century skills are medium size. For the AchSTEM variable, only the intra-correlation between science and mathematics GPA scores is nearly large size. When the inter-correlations in the table are evaluated, most of them are small in size, with the exception of a few moderate ones. For an example, "student negotiation", a dimension of the CLES, demonstrates moderate correlations with dimensions of other scales such as "logical-mathematical intelligence", a dimension of the MII, and "attitude towards 21st century skills", a dimension of the AtSTEM.

Table 4. Correlation Matrix for Observed Variables

	Observed variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
CLES	1. Pers. Relevance	-																					
	2. Uncertainty	.54	-																				
	3. Critical Voice	.36	.36	-																			
	4. Shared Control	.34	.27	.42	-																		
	5. Student Negoti.	.38	.41	.34	.40	-																	
MII	6. Linguistic Intel.	.16	.21	.17	.28	.25	-																
	7. Log.-Math. Inte	.25	.30	.18	.23	.31	.67	-															
	8. Spatial Intelli.	.15	.20	.11	.18	.23	.63	.66	-														
	9. Musical Intelli.	.07	.13	.15	.19	.14	.56	.45	.59	-													
	10. Naturalist Int.	.23	.25	.12	.17	.23	.64	.63	.68	.55	-												
	11. Bod-Kines. Int	.18	.21	.14	.18	.25	.60	.65	.69	.54	.65	-											
	12.Interpers. Intel.	.23	.24	.13	.20	.26	.63	.60	.60	.50	.64	.61	-										
	13. Intraper Intel.	.11	.10	.11	.22	.21	.57	.54	.56	.55	.56	.57	.56	-									
AtSTEM	14. Atti. to math.	.13	.19	.06	.12	.15	.08	.14	.10	.05	.04	.07	.08	.01	-								
	15. Atti. to sci.	.23	.29	.18	.25	.31	.20	.23	.21	.13	.17	.17	.18	.15	.27	-							
	16. Atti. to engin. and tech.	.25	.31	.13	.23	.24	.12	.20	.12	.10	.15	.14	.14	.10	.27	.45	-						
	17. Att to 21th century skills	.27	.37	.15	.21	.34	.19	.21	.12	.14	.17	.13	.17	.15	.25	.50	.59	-					
AchSTEM	18. Science	.22	.30	.15	.15	.21	.07	.20	.09	.05	.06	.14	.09	.01	.22	.24	.06	.16	-				
	19. Mathematics	.16	.25	.16	.13	.21	.06	.19	.07	.01	-.01	.07	.06	.03	.22	.19	.07	.17	.68	-			
	20. Inform. Tech.	.08	.17	.11	.08	.10	.11	.09	.04	.06	.05	.05	.06	.01	.11	.09	.12	.13	.35	.31	-		
	21. Techn. Design	-.04	.08	.03	.09	.13	.09	.07	.06	.01	.03	.04	.03	-	.08	.07	.01	.13	.29	.25	.43	-	
	22. Visual Art	-.06	.02	.08	.06	.08	.10	.11	.10	.05	.05	.04	.03	.06	.10	.10	.10	.10	.15	.17	.26	.36	-

Measurement Models

Before the mediation analysis, measurement models to be included in the structural equations were tested. Four measurement models were tested for: (1) P-CLE, (2) P-MI, (3) AtSTEM, and (4) AchSTEM.

For the P-CLE, five observed indicators were hypothesized. When the measurement model was first tested, good fit indices could not be observed ($\chi^2(5, N = 579) = 51.039$, $p < .001$, GFI = .96, AGFI = .89, RMSEA = .13, SRMR = .05). After a covariance was added between "personal relevance" and "uncertainty" as a result of the suggested modifications, the tested measurement model resulted in good fit indices ($\chi^2(4, N = 579) = 18.292$, $p = .01$, GFI = .99, AGFI = .96, RMSEA = .07, SRMR = .03).

For the P-MI, eight observed indicators were hypothesized. When the model was first tested, although good fit indices could be observed ($\chi^2(20, N = 579) = 77.431$, $p < .001$, GFI = .97, AGFI = .94, RMSEA = .07, SRMR = .03), a covariance between "musical intelligence" and "logical mathematical intelligence" and a covariance between "logical mathematical intelligence" and "linguistic intelligence" were added. Thus, better fit indices appeared finally ($\chi^2(18, N = 579) = 40.577$, $p < .01$, GFI = .98, AGFI = .96, RMSEA = .05, SRMR = .02).

For the AtSTEM, there were four hypothesized indicators, and the tested measurement model directly resulted in good fit indices ($\chi^2(2, N = 579) = 4.156$, $p = .13$, GFI = .99, AGFI = .98, RMSEA = .04, SRMR = .02).

Finally, there were five hypothesized indicators for AchSTEM. The tested measurement model yielded in undesirable fit indices ($\chi^2(5, N = 579) = 132.201$, $p < .001$, GFI = .91, AGFI = .72, RMSEA = .21, SRMR = .11). After adding a covariance between "Science" and "Mathematics", and a covariance between "Technology Design" and "Visual Art", much better fit indices appeared at last ($\chi^2(3, N = 579) = 1.719$, $p = .63$, GFI = .99, AGFI = .99, RMSEA = .00, SRMR = .01).

Mediation Analysis

Mediation analysis was conducted as explained by Baron and Kenny (1986) to explore whether middle school students' constructivist learning environment perceptions mediated the relationship between their P-MI and their AtSTEM and AchSTEM using structural equation modelling by means of "lavaan". What steps mediation analysis has got was explained in the Data Analysis section. In accordance with the relevant explanations, first, the students' constructivist learning environment perceptions were regressed on their P-MI. Second, the students' AtSTEM and AchSTEM were regressed on their P-MI. Finally, in the third step, the students' AtSTEM and AchSTEM were regressed on both their P-MI and on their P-CLE.

When the students' constructivist learning environment perceptions were regressed on their P-MI, the structural equation modelling demonstrated a good fit to the data (χ^2 (61, N = 579) = 150.73, $p < .001$, GFI = .96, AGFI = .94, RMSEA = .05, SRMR = .038) and a significant regression coefficient was observed with nearly large effect size ($\square$=.41, z = 7.33, $p < .001$).

When the students' AtSTEM and AchSTEM are regressed on their P-MI, the structural equation modelling demonstrated a good fit to the data (χ^2 (112, N = 579) = 229.57, p < .001, GFI = .96, AGFI = .94, RMSEA = .043, SRMR = .043). The tested model with estimated parameters is shown in Figure 2. The students' P-MI had a non-significant direct small contribution to their AchSTEM (□=.06, z = 1.13, p = .26) but a significant direct moderate contribution to their AtSTEM (□=.28, z = 4.69, p < .001). The relationship between students' AtSTEM and AchSTEM was also significant with moderate effect size (□=.25, z = 3.57, p < .001). Indirect and total contributions of students' P-MI to their AchSTEM were significant as well (□=.07, z = 3.26, p = .001 and □=.13, z = 2.43, p = .02, respectively).

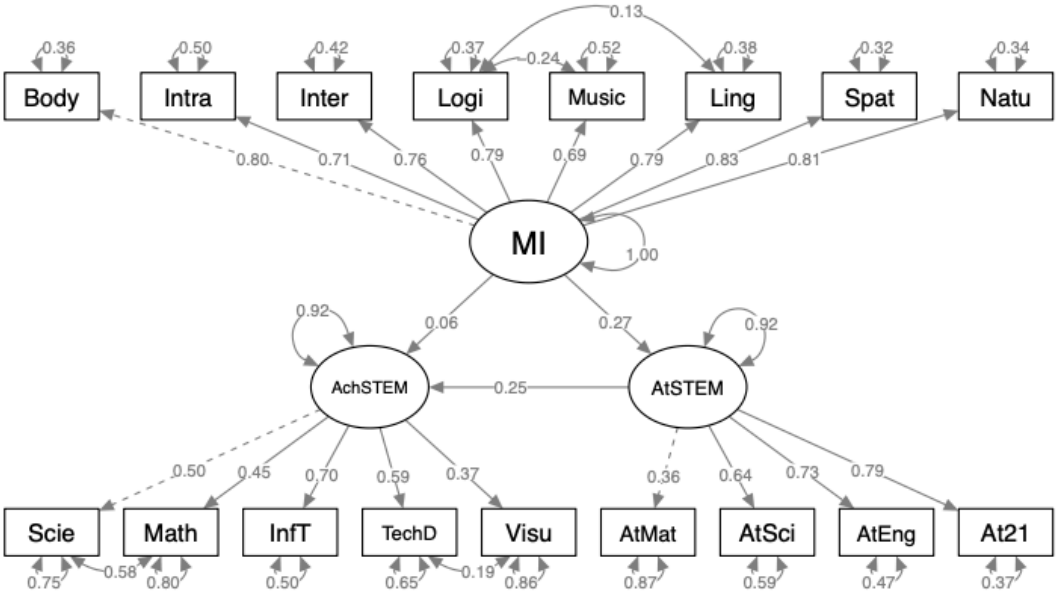

Figure 2. *The students' AtSTEM and AchSTEM are regressed on their P-MI.*

In the last step, the students' AtSTEM and AchSTEM were regressed on both their P-MI and on their P-CLE, and a good fit between the tested model and the data was also observed (χ^2 (198, N = 579) = 437.315, p < .001, GFI = .94, AGFI = .92, RMSEA = .046, SRMR = .049). The tested model with estimated parameters (standardized regression coefficients, covariances, and variances) is shown in Figure 3.

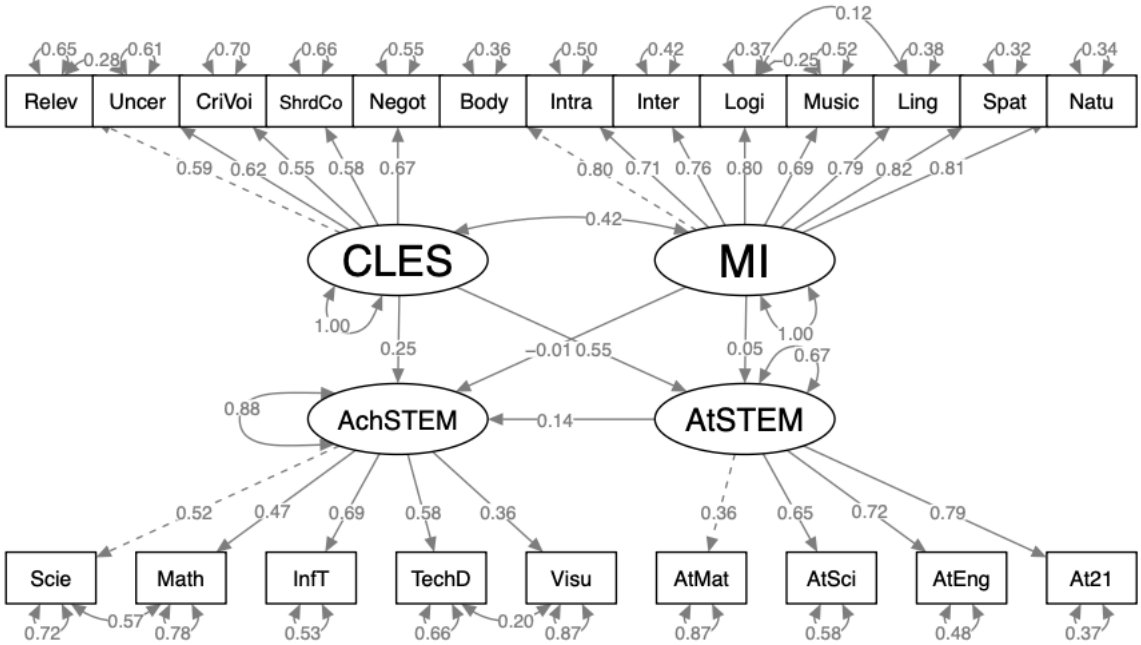

Figure 3. *The students' AtSTEM and AchSTEM are regressed on both their P-MI and P-CLE.*

In addition, Table 5 presents the direct, indirect, and total influences related to the tested model.

Table 5. Direct, Indirect, and Total Relations in Model Tested by means of Structural Equation Modeling

		Attitude towards STEM			STEM Related Courses' GPA Score		
Variable		Direct	Indirect	Total	Direct	Indirect	Total
Multiple Intelligences	β	0.05	-	0.05	-0.01	0.01	0.00
	SE	0.02		0.02	0.04	0.01	0.04
	z	0.88		0.88	-0.11	0.78	-0.00
Constructivist Learning Environment	β	0.55	-	0.55	0.25	0.08	0.33
	SE	0.04		0.04	0.07	0.03	0.06
	z	5.77		5.77	2.79	1.77	4.28
Attitude towards STEM	β	NA	NA	NA	0.14	-	0.14
	SE				0.16		0.16
	z				1.74		1.74

Note, $\chi^2 = 437.315$, $p < .05$, goodness of fit index = .94, adjusted goodness of fit index = .92, root mean square error of approximation = .046; standardized root mean square residual = .049

Findings related to the tested model based on the figure and the table are as follows:

1.Students' AtSTEM had a non-significant small contribution to their AchSTEM (β=.14, z = 1.74, p = .08).

2.Direct influences of the students' P-CLE both on their AtSTEM and AchSTEM were significant (β=.55, z = 5.77, p < .001, and β=.25, z = 2.79, p < .01, respectively). The indirect influence on AchSTEM was non-significant and small (β=.08, z = 1.77, p = .08). However, the total influence was significant with medium size (β=.33, z = 4.28, p < .001).

3.Direct influence of the students' P-MI both on their AtSTEM and AchSTEM were non-significant (β=.05, z = 0.88, p = .38, and β=-.01, z = -0.11, p = .91, respectively). The indirect and total influence were also non-significant (β=.01, z = .78, p = .43; β=.00, z = -.003, p = .99, respectively).

In sum, respectively, 33 and 12 percent of the variances in student AtSTEM and AchSTEM were explained. Almost all these fractions were attributed to their constructivist learning environment perceptions, and the influences of multiple intelligences perceptions vanishes. This means that students' P-CLE seems like a perfect mediator for the relationship between their P-MI and AtSTEM and AchSTEM.

DISCUSSION & CONCLUSION

The main purpose of this study was to clarify the relations of middle school students' P-MI and P-CLE to their AtSTEM and AchSTEM. In particular, the purpose was to investigate whether middle school students' P-MI mediates the relation of their P-CLE to their AtSTEM and AchSTEM, or P-CLE does.

The mediation analysis carried out by means of structural equation modelling clearly demonstrated that middle school students' P-CLE perfectly mediated the relationship between their P-MI and their AtSTEM and AchSTEM. The indirect and total relationships of the P-MI to AchSTEM through AtSTEM were significant with small effect sizes. However, this may not mean that the relation of P-MI to AtSTEM and AchSTEM is small in reality because the MI items can cover only a small part of total spectrum of abilities in each intelligence category (Armstrong, 2000). Findings of associational research exploring the relationships between P-MI and academic performance in STEM disciplines also yield positive relationships (Ahvan & Pour, 2016; Baran & Maskan, 2011; Chan, 2006; Lillbacka, 2013; Pallrand & Seeber, 1984; Snyder, 1999; Träff et al., 2019). Although those studies reported relations of the dimensions of P-MI to academic achievement, they did not report how much variance in the achievement had been accounted for.

When the P-CLE entered the equation, the significant relation of P-MI vanishes and becomes zero. That is, a perfect mediation was the case, and the P-CLE perfectly mediate the relation of the P-MI to the AtSTEM and AchSTEM. It means that the students with high level of P-MI perceive the learning environment provided to them as more constructivist and positive; thus, they are more successful in STEM courses as well. In the Akdağ and Köksal (2022) study, the researchers also used the CLES to assess gifted students' P-CLE, and they observed that the gifted students had found the learning environments provided to them totally constructivist. That is, those students thought that they took more responsibility than their counterparts for learning new concepts, and they

were active learners in the classroom. In another research, Rita and Martin-Dunlop (2011) compared 146 gifted and 115 non-gifted high school biology students' perceptions of learning environments. They reported that all the participants preferred more favorable learning environment than the one they were experiencing. However, the gifted students' perceptions of learning environments were more positive. Similar conclusions come from the Schijndel et al. (2018) study as well. They observed the primary school students with low intelligence perceptions had benefitted from inquiry-based instruction with higher quality of exploration except for the knowledge acquisition. In other words, they also observed that the students who perceived themselves as low intelligent had not been able to benefit from the inquiry-based instruction that provide a constructivist environment in terms of knowledge acquisition or academic performance.

Consequently, the students who perceive themselves as more intelligent tend to find the learning environments provided to them more constructivist in general. There is an extensive literature on the relationship between students' perception of learning environment and their achievement in STEM disciplines. Almost all studies found positive but small relationships between student perceptions of learning environment and AtSTEM and AchSTEM (Allen & Fraser, 2007; Aluri & Fraser, 2019; Boz et al., 2016; Chionh & Fraser, 2009; Fraser & Kahle, 2007; Goh & Fraser, 1998; Hafızoglu & Yerdelen, 2019; Ogbuehi & Fraser, 2007; Pamuk et al., 2017; Partin & Haney, 2012; Wolf & Fraser, 2008; Yang, 2015), except for few studies could not observe a significant relationship (e.g. den Brok et al., 2010). In constructivist learning environments, learners make sense of the world in relation to the knowledge they have already constructed and this process takes place by means of active negotiation with teacher and peers (Fraser, 1998; Taylor et al., 1997b). Obviously, this active participation should help students improve their academic performance; and thus, it may also help them feel smarter or more intelligent as well.

As providing students with constructivist learning environments may help them feel more intelligent, feeling themselves more intelligent may be helping them profiting more from the constructivist learning environments provided to them. Such a perspective is a natural result of associational research studies. That is say, perceptions of intelligence may be something expandible with some limitations. Dweck and her colleagues observed students to hold two types of views about intelligence: entity and incremental theories of intelligence (as cited in Aronson et al., 2002). They reported the students with the entity view of intelligence to possess "performance goals." They desire to show their intelligence and tend to prefer tasks which will verify that they are intelligent and capable. On the other hand, students with the view of incremental view of intelligence are reported to possess "learning goals." They tend to learn new concepts to improve their competence. When a challenging task is the case, the students with the entity theory demonstrate disengagement while the students with the incremental theory increase their engagement with less anxiety. That is to say, students perceive the constructivist learning environments to be more challenging as reported in the Shekhar et al. (2020) study because such environments require them to be more active and responsible. Therefore, students with the entity view of intelligence may become disengage in constructivist learning environments that are perceived as offering them more challenging tasks; and thus, they become less successful. If this is the case, even simply stating them intelligence is something malleable and can be improved may help them benefit more from the constructivist learning environments as Aronson et al. (2002), and Marchand and Taasoobshirazi (2013) did in their experimental research.

As a result of this study and the related literature, the following recommendations could be considered:

1.Because quantitative assessment of student aptitudes such as intelligence and skills may not reflect the true scores, researchers may conduct qualitative exploration of relationships between multiple intelligences, constructivist learning environment, and AtSTEM and AchSTEM so that a more realistic and deeper understanding about those relationships may be constructed.

2.Students may be provided with constructivist learning environments so that they become more successful, and thus, feel more intelligent.

3.Multiple intelligence theory laden interventions may help students more profit from the instructions and thus be more successful as well.

4.Students should be encouraged to think of intelligence as something malleable by guidance so that their perception of multiple intelligences may be improved; and thus, they may more benefit from constructivist learning environments.

5.Experimental research on reducing the stereotype threat should be conducted to test if simply encouraging students to think of intelligence as something malleable can improve their perceptions of multiple intelligences;

and thus, can improve their academic performance.This section may include the discussion of your findings, and conclusions with comparison to the literature, implications, and recommendations.

Statements of Publication Ethics

This study was approved by the Social and Human Sciences Research Ethics Committee, and the authors declare that there are no conflicts of interest of any kind.

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This article is based on the master's thesis written by Güler (2019) and supervised by Haki Peşman.

Researchers' Contribution Rate

Haki Peşman: Supervision, Conceptualization, Project administration, Methodology, Software, Investigation, Writing- Reviewing and Editing **Tuba Güler:** Conceptualization, Methodology, Data curation, Writing- Original draft. **Üzeyir Arı:** Visualization, Investigation, Writing- Original draft. **Fatma Erdoğan:** Validation, Investigation, Writing- Reviewing and Editing.

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Haki	☒	☒	☐	☒	☒	☒
Tuba	☐	☒	☒	☒	☐	☐
Üzeyir	☒	☐	☐	☒	☒	☒
Fatma	☒	☐	☐	☐	☒	☒

Conflict of Interest

The authors declare that there are no conflicts of interest of any kind.

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A Comparative Analysis of Questioning and Responding Strategies Used by Mothers of Gifted and Typically Developing Children

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Abstract

This study compares the questioning and responding strategies used by mothers of gifted and typically developing children towards their children. For this purpose, a qualitative approach using semi-structured interviewing with 44 mothers – 19 mothers of gifted children and 25 mothers of typically developing children – was conducted. The findings show that mothers of gifted children mostly use hypothesis, interpretation and reflective question types while asking questions to their children, whereas mothers of typically developing children mostly use inference and interpretation question types. Regarding responding strategies, the study shows that mothers of gifted children mostly answered their children's questions with explanations based on cause-effect relationships and encouraged collaboration while answering, on the other hand, mothers of typically developing children mostly answered their children's questions by explaining them with examples. This study makes important contributions to the influence of question-answer communication in the mother-child relationship on shaping the child's cognitive developmental pathways and the ecological aspect of giftedness.

Keywords: Giftedness, questioning strategy, responding strategy, maternal interaction, interview, thematic analysis.

Özel Yetenekli ve Normal Gelişim Gösteren Çocukların Annelerinin Kullandıkları Soru Sorma ve Cevap Verme Stratejilerinin Karşılaştırmalı Bir Analizi

Öz

Bu çalışma özel yetenekli ve normal gelişim gösteren çocukların annelerinin çocuklarına yönelik kullandıkları soru sorma ve cevap verme stratejilerini karşılaştırmaktadır. Bu doğrultuda, 19 özel yetenekli çocuk annesi ve 25 normal gelişim gösteren çocuk annesi olmak üzere 44 anne ile yarı yapılandırılmış görüşmeler kullanılarak nitel bir yaklaşım yürütülmüştür. Bulgular, özel yetenekli çocukların annelerinin çocuklarına soru sorarken çoğunlukla hipotez, yorumlama ve yansıtıcı soru türlerini kullandıklarını, normal gelişim gösteren çocukların annelerinin ise çoğunlukla çıkarım ve yorumlama soru türlerini kullandıklarını göstermektedir. Cevap verme stratejileri açısından özel yetenekli çocukların annelerinin çocuklarının sorularını çoğunlukla neden-sonuç ilişkilerine dayalı açıklamalarla cevapladıklarını ve bu süreçte işbirliğini teşvik ettiklerini, normal gelişim gösteren çocukların annelerinin ise çocuklarının sorularını çoğunlukla örneklerle açıklayarak cevapladıklarını göstermektedir. Bu çalışma, anne-çocuk ilişkisinde soru-cevap iletişiminin, çocuğun bilişsel gelişim yollarını şekillendirmedeki etkisine ve özel yetenekliliğin ekolojik boyutuna önemli katkılarda bulunmaktadır.

Anahtar kelimeler: Özel yeteneklilik, soru sorma stratejisi, yanıt verme stratejisi, anne tarafından etkileşim, görüşme, tematik analiz.

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INTRODUCTION

There has been a paradigm shift in giftedness studies, although genetic studies on intelligence continue (e.g., Barbey et al., 2014; Hill et al., 2014; Zhao et al., 2014). Multifaceted models considering broader individual characteristics and environmental influences are now being studied (e.g., Barab & Plucker, 2002; Gagne, 2005; Sternberg, 2017; Ziegler, 2005). This change highlights the physical and social features of the family environment as critical to developing giftedness. For example, to foster giftedness in the home environment, books (Stoeger et al., 2014), educational materials, and artistic and musical stimuli (Melhuish et al., 2008; Weissler & Landau, 1993), parents' socioeconomic status (Olszewski-Kubilius, 2000), as well as shared leisure activities (sports, cultural events, social visits) (Ferreira & Fleith, 2012), are all accepted as crucial factors.

Research emphasises the important role of parents in supporting the development of giftedness in children (e.g., Al-Shabatat et al., 2009; Aspesi & Fleith, 2006). Parental attributes, attitudes, values, expectations (Gross, 2004; Stoeger et al., 2014), and behaviours (Lee & Bowen, 2006; Stoeger et al., 2014) have been noted to impact children's gifted performance. Current studies in the relevant literature have predominantly focused on general parental attitudes on the cognitive development of children (e.g., Busch et al., 2018; Gauvain, 2001; Legare et al., 2017), the role of parent-child interaction in developing children's independent problem-solving and learning (e.g., Dieterich et al., 2006; Mermelshtine, 2017). However, the specific impact of parents' questioning and responding strategies on nurturing giftedness remains underexplored. Addressing this research gap, our study aims to investigate the questioning and responding strategies used by mothers of gifted and typically developing children, highlighting distinctions between the two groups. While it is crucial to examine the questioning behaviours of both parents (Rowe et al., 2017), this study specifically focuses on maternal questioning and responding strategies due to the predominance of mothers as primary caregivers. Guided by this focus, our research question is: "How do the questioning and responding strategies used by mothers of gifted children differ from those used by mothers of typically developing children?"

Role of Questioning in Higher Order Thinking Skills

Questioning and responding, fundamental teaching and learning components since Socrates' era, have enduring significance. While diverse perspectives exist on the definition of questioning (Watson, 2018), our emphasis lies in its educational context. Extensive research spanning problem-based learning, curiosity, and inquiry scaffolding, attests to the potency of questions as pedagogical tools (Schwartz et al., 2016). Profound questioning empowers educators to unravel the mystery of students' thinking (Costa & Kallick, 2015). A cost-effective and accessible means to cultivate critical and creative thinking is through adept questioning (Voss, 1987). Skillful questioning augments academic achievement (Von Secker, 2002), facilitates language acquisition (Blewitt et al., 2009), and bolsters content comprehension (Haden et al., 2015).

The nexus between questioning and learning is forged through thinking, a cognitive process that reshapes information in novel ways (Willingham, 2009). Learning is propelled by thinking, substantiated by studies (Alexander et al., 2022; Vermette, 2009). Without thought, learners cannot assimilate novel concepts into their existing mental frameworks (Schwartz et al., 2016). Learning stems from the stimulating nature of questions as students think and transition to learning (Lyman, 1987). This highlights the substantial metacognitive value inherent in questioning. In this perspective, effective questions yield cognitive development, fostering curiosity, motivation, attentiveness, and memory consolidation (Schwartz et al., 2016). Skillful questioning strategies engender meaningful learning and understanding by inciting students' internal thinking processes (Alexander et al., 2022).

Despite extensive research on teachers' questioning strategies for developing higher-order thinking skills in gifted education programs (e.g., Davis & Rimm, 2004; Feldhusen, 1994; Gallagher, 1985; VanTassel-Baska, 2006) and fostering an inquiry-based classroom climate (Gallagher, 1985; VanTassel-Baska, 2006), there has been limited focus on the questioning and responding strategies used by parents of gifted children within the early home environment. Notably, the influence of the early home environment on language, cognitive, and social development is well-established (White et al., 1979; Morrow, 1983), with parents serving as pivotal early educators (Davis & Rimm, 2004). Parent-child conversations significantly contribute to children's thinking and learning (Frazier et al., 2009), and questioning is a recurrent aspect of parental discourse from an early age (Kurkul & Corriveau, 2018).

Parent-child questioning interactions begin as early as 5 months of age and persist throughout childhood (Bornstein et al., 1992; Ervin-Tripp & Miller, 1977). Such rich engagements enhance language development, and

language skills are closely tied to cognitive abilities (Huttenlocher et al., 2002). Consistent, stimulating verbal exchanges correlate with improved cognitive outcomes in children (Weizman & Snow, 2001). Mothers who use diverse questioning approaches, offer positive responses and engage in extensive verbal dialogues help to advance their children's cognitive development (Berk, 2008; Huttenlocher et al., 2002). Hence, an essential inquiry arises: What is the distinct questioning and responding approaches experienced by gifted and non-gifted children within their early home environment?

Art of Questioning

Facilitating the creation of thought-provoking questions that stimulate critical thinking, deepen understanding, and foster intellectual development in students calls for integrating Bloom's Taxonomy (1956) as a foundational framework for educators' questioning strategies. Notably, scholars such as Gallagher (1985), Patterson (1973), Pollack (1988), and Wolf (1987) have underscored the significance of applying Bloom's taxonomy to structure questions across its levels, particularly emphasizing the higher-order domains of knowledge, comprehension, application, analysis, synthesis, and evaluation. This taxonomy, renowned for categorizing educational objectives, is pervasive in K-12 and higher education classrooms, contributing to teaching practices (Armstrong, 2010).

A group of cognitive psychologists, curriculum theorists, instructional researchers, and assessment specialists have revised and restructured Bloom's Taxonomy into six key categories, each designated with active verbs: (1) remembering (recalling and recognizing information), (2) understanding (comprehending and interpreting information), (3) applying (using knowledge, concepts, or principles to solve problems), (4) analysing (breaking down information and exploring relationships or structure), (5) evaluating (making judgments, assessments, or critiques based on criteria), and (6) creating (generating novel ideas or products by combining existing knowledge in innovative ways) (Anderson & Krathwohl, 2001). This updated taxonomy emphasizes higher-order skills such as analysis, assessment, and creativity, in contrast to the earlier version, emphasising lower-level cognitive processes like knowledge and comprehension.

The updated version acknowledges the need for students to acquire essential skills and competencies such as critical thinking, problem-solving, and creativity, vital for success in today's intricate and rapidly evolving world. Introducing the creating level as the pinnacle of cognitive complexity underscores generating new ideas, products, or viewpoints by synthesizing existing knowledge and concepts. The definitions of each level in the revised taxonomy aim to illustrate the incremental nature of learning and the escalating intricacy of thinking skills as one ascends the taxonomy. In essence, the updated Bloom's Taxonomy retains the foundational structure of the original version while enhancing it through a heightened emphasis on higher-order thinking, modernizing the vocabulary, and adjusting to current educational demands. In this study, we juxtaposed the questioning strategies used by mothers of gifted and typically developing children, adapting the classroom environment of teachers to the home setting of mothers, within the framework of Wolf's (1987) question types based on Bloom's Taxonomy, as depicted in Figure 1 below.

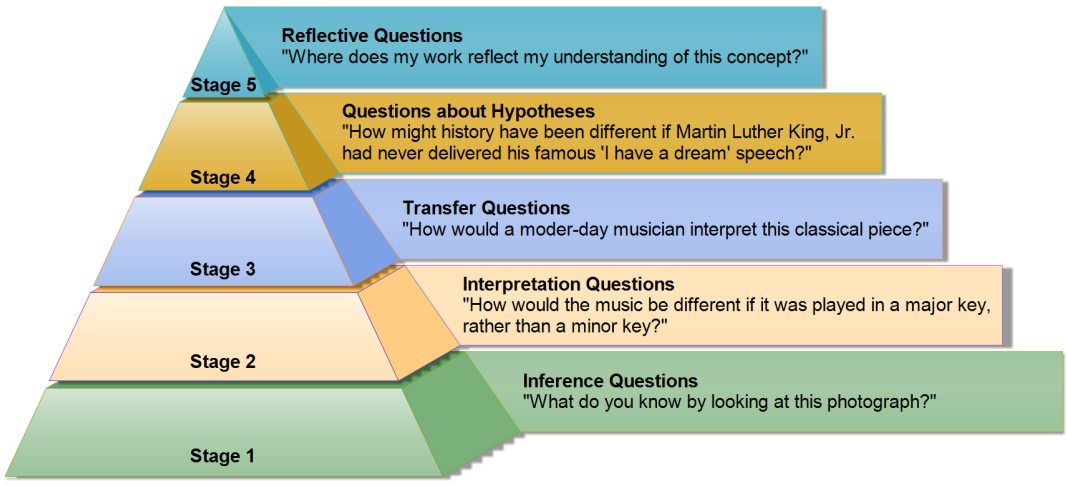

Figure 1. *Pyramid of the art of questioning (adapted from "The Art of Questioning," by D. P. Wolf (1987)).*

Inference questions encompass memory, knowledge, and comprehension, prompting students to surpass readily available information with a descriptive intent – inquiring about who, what, where, when, and how (Wolf, 1987). For example, consider this photograph's implications. Children are tasked with discerning content cues (where and when the photo was taken), technical aspects (where the photographer stood and where the light sources were located), and semantic nuances (how the photographer feels about the content of the photography). This approach encourages children to deduce, analyse, and deliberate over confirmed inferences, constituting fundamental inquiry that involves interpreting clues, predominantly featuring questions admitting a singular correct response.

Interpretive questions foster children's comprehension of information's consequences, prompting critical thinking instead of merely completing gaps or adjusting solutions, as seen in inference questions (Wolf, 1987). For example, an art teacher might challenge a student to assess a portrait, gauging the impact of removing a specific element. When presenting interpretive queries, one could ask how a young person's life might shift if they opt out of college or early marriage (Shaunessy, 2000). These queries follow an open-ended structure, allowing varied correct responses promoting divergent thinking (Pollack, 1988). While assessing such answers is challenging due to a lack of guidelines, they cultivate a learning environment esteeming the process of arriving at answers more than the answers themselves (Pollack, 1988).

While interpretive questions delve deeper, *transfer questions* prompt expansive thinking, pushing children to apply knowledge in novel contexts (Wolf, 1987). For example, how might Shakespeare have portrayed contemporary conflicts? How could a modern filmmaker interpret historical events? Transfer questions meld knowledge and interpretation for new situations. Predictive thinking, typically linked to sciences, is vital across hard disciplines. Nonetheless, predictive thinking, tied to *hypotheses,* holds significance across all domains. This question format centres on predictions beyond existing knowledge, interpretation, and transfer (Wolf, 1987). For example, how would the civil rights movement have evolved if Martin Luther King, Jr. had not given his iconic "I Have a Dream" speech? Based on current societal challenges, what do you predict will be the predominant themes and narratives explored in future movies, novels, and plays?

Reflective questions encourage children to reflect on their thought processes and evaluate their metacognitive strategies (Shaunessy, 2000). In discussions, meaningful exchanges arise through reflective thinking and questioning. In planning follow-up questions, the questioner should seek clarification on unclear ideas (Will, 1987). For example, how does this work mirror my beliefs? Where does it display my unique perspective? Children must comprehend their thought processes, rationale, and the factors shaping their conclusions. This approach directs learning toward probing their ideas, fostering extended discussions, and converting their statements into thought-provoking questions (Letzter, 1982). Research shows that answers are as important as questions in child development. For example, Maker and Nielson (1996) stress avoiding formulaic replies to nurture student engagement; responses like "Yes, I see, okay, fine" may devalue contributions. However, paying close attention to when and how a teacher reacts can convey to pupils that their thoughts are "worthwhile, significant, pertinent, or sincere"; for example, "Yes, I can understand that; I see what you mean, I hadn't thought of that before, and that makes a lot of sense" (Maker & Nielson, 1996, p.48).

Context of the Study: Türkiye

In Türkiye, the Ministry of National Education has employed specially talented term since 2013 to designate gifted individuals (Gucyeter et al., 2017). This paper uses gifted term to provide international intelligibility. The Turkish Ministry of National Education Special Education Services Regulation defines a specially talented individual as "one who is quick in learning in comparison with his/her peers, is advanced in the capacity of creativity, art, leadership, possesses the special academic ability, understands abstract ideas, loves to act independently in his/her interests and performs at a high level" (MoNE, 2016, p. 450). This definition underscores giftedness as multifaceted. Nevertheless, identifying gifted children remains largely reliant on individual intelligence tests.

In Türkiye, the General Directorate of Special Education and Guidance Services annually actualises the identification of gifted children in primary and secondary schools through three stages: (1) teacher-recorded observation forms, (2) group tablet-based testing, and (3) individual IQ (intelligence quotient) assessments (MoNE, 2017-2018). Upon successful completion of these stages, the child is identified as gifted and shows the potential to be able to access a variety of educational options such as special schools, special classes and after-school programmes. Special schools encompass science high schools, social science high schools, conservatories, fine arts, and sports high schools. Special classes host resource rooms, fostering individual curriculum adjustments

for specially talented students. After-school programs involve Science and Art Centers (SACs) and child universities (Gucyeter et al., 2017). SACs serve gifted students in painting, music, and general intellectual ability, nurturing abilities without interrupting their formal education (MoNE, 2017-2018).

METHOD

Research Design

A qualitative approach was chosen due to its capacity for deep exploration of intricate social dynamics (Creswell & Poth, 2018). This method facilitated comprehensive insights into maternal beliefs, attitudes, and behaviours concerning their children's interactions with them, accounting for cultural and environmental influences (Denzin & Lincoln, 2018). The interviews were conducted to gather detailed self-reported data to address the research question in-depth and comprehensively. Ten semi-structured interview questions were prepared (see Appendix A). These questions were informed by examining the relevant literature to discuss key issues (Hennink, 2007). The questions used in this study were arranged by taking expert opinions. Necessary revisions were made in line with the feedback from experts. Before the main study, three pilot interviews ensured mutual comprehension. Interviews were actualised in person and audio-recorded to ensure accurate data collection and participant representation.

Participants and Data Collection

Given the underrepresentation of economically disadvantaged students in gifted programs (Plucker et al., 2010), this group was chosen to contribute to inclusive identification and support policies and interventions for all socioeconomic backgrounds. With 19 primary schools in the district, the school with the largest number of students was selected to ensure an adequate participant pool. The school's headteacher was interviewed after university ethical approval and sample group determination. The school's student body comprises predominantly Turkish and Muslim families of low socioeconomic status. Following communication with the headteacher, information sheets and consent forms were provided to mothers of gifted and typically developing children. Interview appointments were arranged with volunteer mothers. All interviews were conducted in person and audio-recorded for accuracy and participant integrity. In total, 44 mothers were interviewed; 19 participants were mothers of children identified as gifted and receiving education in SACs in addition to formal education. The remaining 25 participants were mothers of children who had not been involved in the identification tests, demonstrated typical development, did not require special education, and were engaged solely in formal education. The demographic details of the participants are presented in Table 1 below.

Table 1. Demographic Characteristics of the Mother Sample of Gifted and Typically Developing Children

Characteristics	Mother sample of typically developing children	Mother sample of gifted children
Gender		
Female	25	19
Age group of mothers		
30-39	18	13
40-49	7	5
50-59	-	1
Graduation degree of mothers		
Primary school graduate	15	2
Secondary school graduate	3	4
High school graduate	6	6
Bachelor's degree	1	6
Postgraduate degree	-	1
Gender of children		
Male	13	9
Female	12	10
Age group of children		
8-9	7	9
10-11	18	10
School year of children		
Year 1	-	3
Year 2	7	6
Year 3	14	7
Year 4	3	3

The distribution of participating mothers in both groups aligns. For example, within the 30-39 age range, 18 mothers with children identified as gifted and 13 mothers with typically developing children. Likewise, the 40-

49 range includes 7 mothers with children identified as gifted and 5 mothers with typically developing. Only one mother with a child identified as gifted is over 50, which is not expected to impact study results. The broad participant age range within each group (30-49 for the mothers of typically developing children, 30-59 for the mothers of gifted children) is notable. Given the similarity in responses within each group, the extensive age range is unlikely to affect study outcomes significantly. Similarly, the age distribution of children in both groups is aligned, all primary school students. Thus, this age alignment is not anticipated to yield divergent research findings.

Differences in maternal education levels between the groups, outlined in the conclusion, represent a study limitation. However, these variations are not likely to heavily influence outcomes. Our aim wasn't to assess how maternal education impacted giftedness or gifted performance. Rather, we focused on examining the differences in questioning and responding strategies used by mothers of gifted and typically developing children. Examining underlying factors driving these differences might fuel future research, creating new investigative paths. Within this framework, maternal education discrepancies, while limitations, don't overshadow findings and may incite novel research avenues.

Data Analysis

Considering the study's purpose and research question, we employed thematic analysis, which provides rich and detailed results and reports participants' experiences, meanings and reality (Braun & Clarke, 2006). We aimed to uncover meaning patterns and offer explanatory insights rather than formulating new theories. Initially, interview notes were translated from Turkish to English, ensuring fidelity. The first author, proficient in both languages, conducted the direct translation, which was subsequently reviewed for consistency and adherence to the original meaning by two bilingual researchers. No discrepancies or ambiguities emerged.

Following Braun and Clarke's guidelines (2006), we undertook a systematic process; closely reading each transcript, generating initial codes, deriving potential themes based on code semantics, reviewing and structuring themes into a map, and ultimately describing these themes. All data were manually and thematically coded through a data-driven inductive approach, with all codes deemed significant. The first author conducted coding, which the second author verified. Subsequently, a third independent reviewer joined the coding process, bolstering the results' credibility and the findings' robustness. Post-coding, responses underwent a comprehensive review to ensure intra- and inter-participant consistency. A total of 109 codes and 5 themes were generated in the study: (1) the importance of asking children questions from mothers' perspectives, encompassing 31 codes; (2) question structuring styles of mothers for their children, with 15 codes; (3) responding styles of mothers for their children, featuring 22 codes; (4) mothers' approach to their children's questions, comprising 34 codes; and (5) mothers' approach to their children's responses, with 7 codes. Appendix B contains the code list.

Research Ethics

Before the data was collected, a strict methodology was followed in accordance with the 2011 Ethical Guidelines published by the British Educational Research Association (BERA). Through extensive verbal and written disclosure, each participant received a thorough explanation of the goals and methods of the study. Participants had to sign a consent form indicating their explicit approval before participating. Participants are reassured of the rigorous ethical standards controlling the study by the clear promise to maintain confidentiality and guarantee anonymity.

FINDINGS

This section is organized based on the five themes, with each theme presenting its respective findings under a dedicated heading.

Theme 1: Importance of Asking Children Questions from Mothers' Perspectives

The initial theme delves into how mothers of gifted and typically developing children assess the importance of asking questions for their children and for what purpose they ask them. Mothers of typically developing children prioritize imparting and enhancing their children's knowledge, teaching unfamiliar concepts, and ensuring enduring comprehension through their questioning. They view questioning as facilitating their children's further and permanent learning. For example:

"Asking questions is vital for the child's development because the child learns by asking questions, and the answers we give to the questions they ask are more permanent in their minds."

"It is crucial in terms of gaining awareness about learning consciously."

Five mothers of typically developing children emphasize the significance of asking questions for nurturing social skills. They recognize questions as instrumental in promoting self-expression, gaining self-confidence, supporting language development, enhancing speaking skills, and facilitating communication. For example:

"I see it as important in terms of being able to express himself/herself more easily and contributing to his/her social skills."

"…asking questions to children is essential as it develops their speaking skills."

Among mothers of typically developing children, five highlight the importance of questioning to alleviate uncertainty and satiate curiosity, while three focus on fostering cognitive and thinking abilities, enabling problem-solving, and encouraging detailed thought. Two mothers view questioning as a means to understand their children better. In contrast, three mothers consider asking questions less pertinent to their children's development. Analysing responses from mothers of gifted children, a prevalent perspective is the emphasis on nurturing the child's cognitive and thinking skills. According to seven mothers, asking questions proves to be an effective strategy for stimulating thought processes, engaging in mind exercises, and developing problem-solving skills. For example:

"It's important. I think it does mind exercise while thinking about the answer."

"Asking questions encourages the child to think, and in this way, the development of both cognitive development and thinking skills is supported."

Parallel to the responses from mothers of typically developing children, five mothers of gifted children emphasize the significance of asking questions in contributing to the child's social skills. According to these mothers, asking questions facilitates self-expression and supports the child's self-confidence. For example:

"It is important to ask children questions as they enable them to express themselves better in a social environment."

Resembling the responses from mothers of typically developing children, four mothers of gifted children perceive asking questions as vital for enhancing their child's learning process. They regard asking questions as a tool to accelerate learning, support knowledge accumulation and make connections. Furthermore, three mothers highlight asking questions' role in nurturing their child's curiosity. While both mother groups value the development of cognitive, thinking, learning, and social skills through asking questions, the mothers of gifted children tend to emphasize cognitive and thinking abilities, such as problem-solving and critical thinking, deeming these crucial for intellectual development. Conversely, mothers of typically developing children primarily emphasized learning skills encompassing academic knowledge, study techniques, and information retention. While learning skills and cognitive and thinking skills are interconnected in education and psychology, distinctions exist between them.

Theme 2: Question Structuring Styles of Mothers for Their Children

The second theme explores how mothers of gifted and typically developing children design their questions and the question types used. Over half of the mothers of typically developing children use descriptive question structures (e.g., who, what, where). Their questions comprise straightforward knowledge inquiries, closed-ended questions, and questions targeting learning from mistakes to avoid recurrence. For example:

"During the day, I ask about everything about the school, at home and outside, such as who, what, and where."

"In general, my questions are constructive; that is, the aim is to ensure that the child learns from his mistakes and does not repeat the same mistakes."

This question type mirrors Wolf's (1987) inference questions in structure and intended response. Over half of the mothers of typically developing children use inference questions, targeting memory, knowledge, and comprehension domains. This type, deemed basic, predominantly features single-answer questions (Wolf, 1987). Nearly half of the mothers of typically developing children use interpretive questions featuring directives (e.g., if you do this, what will happen?) and questions focusing on the how aspect. For example:

"I mostly use the question of how and try to ask it by using directive phrases such as what will happen if you do so? This requires the child to make a comment."

"I ask critical questions; that is, since I am curious about his interpretation, I try to ask questions that require his interpretation."

This shows that approximately half of the mothers of typically developing children use interpretive questions in the second stage of Wolf's (1987) question framework. This question type aims to deepen children's

comprehension and stimulate critical thinking. The findings imply these mothers promote a learning process conducive to cognitive advancement and creative problem-solving. They use open-ended questions, inviting multiple valid answers fostering divergent thinking (Pollack, 1988; Wolf, 1987). In contrast to the mothers of typically developing children, approximately half of the mothers of gifted children use questions concerning outcomes, predictions, cause-and-effect dynamics, and reasoning (e.g., why it happens and/or how it is composed) for their children. For example:

"I don't know. I never thought of that. But I always focus on cause-and-effect relationships in my questions. Therefore, the child can develop a prediction or reach a result by focusing on this relationship."

The applied question types align with Wolf's (1987) fourth-stage hypothesis questions that foster predictive thinking skills. These questions encourage children to predict beyond their current knowledge, interpretation, and transfer. Among mothers of gifted children, three utilize questions promoting critical thinking, creativity, self-awareness, and purposeful inference (e.g., reasoning). For example:

"I try to ask questions that will enable my child to think critically and improve his questioning awareness. Questions for which there is not always one answer, so I try to ask questions that will make him think by focusing on why he thinks so and questions about many answers."

"The child's questions are independent of the patterns, much more creative and much more meaningful."

"That's why I care about asking questions that will develop my child's creativity and reach his new ideas with his own self."

These question types used by mothers align with Wolf's (1987) fifth-stage reflective questions, designed to prompt children to contemplate their thinking processes and assess their metacognitive strategies (Shaunessy, 2000). This approach facilitates meaningful idea exchange through reflective thought and questioning (Will, 1987), encouraging deeper thinking (Letzter, 1982). Among mothers of gifted children, four use interpretation questions (e.g., explanation-based: what will happen/what do you think?), while four utilize inference questions (e.g., descriptive: what/where?) for their children. Notably, both mother groups use inference and interpretation questions, not transaction questions. The findings reveal that while mothers of typically developing children predominantly use 1st and 2nd stage questions (inference and interpretation), over half of mothers of gifted children use 4th and 5th stage questions (hypotheses and reflective).

Theme 3: Responding Styles of Mothers for Their Children

The third theme examines how mothers of gifted and typically developing children address their children's questions. Except for three mothers, all mothers of typically developing children consider it important to address their children's questions. Among them, eight mothers emphasize the importance of responding to satisfy their child's curiosity, two prioritize showing interest in their child, and one mother considers the potential impact of her answers on her child's decisions. However, eleven mothers did not provide specific details regarding their viewpoint. For example:

"If a child asks a question, he/she is asking because he/she is curious. I answer to satisfy my child's curiosity. That's why I think it is crucial to answer to satisfy the child's curiosity."

"It is important to answer the child, not to keep the child wondering."

"It is necessary to answer the child's questions because our answers affect the child's decisions."

Analysing how mothers of typically developing children respond to their children's questions reveals several patterns; nine mothers tend to provide explanations and examples, three mothers simplify their explanations based on the child's age, three mothers use yes or no responses, three mothers focus on making the child's question more meaningful and understandable, two mothers respond positively to avoid upsetting the child, one mother instructs the child on what to do, and four mothers did not specify their responding approaches. For example:

"First, I explain the concepts in the question he asks and then give examples about it."

"I use expressions like yes or no. Sometimes these may require me to make a short explanation."

"I first inquire about the question he asks to see whether it is meaningful and understandable. I answer after I fix his question."

Reviewing responses from the mothers of gifted children, it becomes evident that all mothers consider responding to their children's questions important. Four mothers emphasize contributing to their child's cognitive development, two focus on supporting understanding, learning, and knowledge transfer, one aims to address the

child's uncertainties, and one expresses interest in the child. However, eleven mothers did not elaborate on the specific aspects of importance. For example:

"I must answer my child's questions because his questions will contribute to his cognitive development. The answers we give will also contribute to his cognitive development."

"Answering the child is as important as asking questions because providing understanding, learning, and transferring of the child requires a question-and-answer circulation."

Examining the responses of the mothers of gifted children to their children's questions reveals that twelve mothers explain answers in terms of cause-and-effect relationships and propose collaborative research. Four mothers employ a simplified explanation approach tailored to their child's age, akin to the responses of the mothers of typically developing children. Two mothers encouraged self-reliant responses from the child, while one mother did not specify her approach to responding. For example:

"I'm trying to give him the answer by explaining it in detail, and I offer to research it together. I usually explain these answers to him with cause-and-effect relationships."

"I try to listen carefully until my child's question finishes, and I try to explain in as much detail as possible, and then I suggest we research together more."

Among the mothers of gifted children, emphasizing cognitive development, understanding, and learning is the prevalent response concerning the significance of addressing children's questions. Mothers of gifted children predominantly explain answers in cause-and-effect terms and encourage joint research in their responses to children's questions.

Theme 4: Mothers' Approach to Their Children's Questions

Within the context of the theme, we transition from discussing mothers' questions to their children's questions. This section encapsulates mothers' perspectives on the significance of their children's questions and their actions to foster a culture of questioning. Among the mothers of typically developing children, nine acknowledge the importance of children's questions in comprehending their world and understanding them better. Additionally, six mothers emphasize the role of questions in promoting the child's learning, while four highlight their function in satisfying the child's curiosity. One mother notes their potential to increase the child's curiosity, one sees them as a means to prevent mistakes, and five mothers abstain from expressing their viewpoints. For example:

"If the child asks a question, they want to learn something. We must also respond to the child's desire to learn. We support the child's learning with their questions."

"The child's questions give us an idea about the child's world. It allows us to get to know our children."

Regarding the strategies used by mothers of typically developing children to foster their children's inclination to ask questions, fifteen mothers disclosed that they do not enact deliberate measures for encouragement. Conversely, three mothers motivate their children to pose questions by fostering an environment where the child feels at ease asking and communicating. An additional two mothers guide their children to discuss personal experiences, while another two prompt discussions through the presentation of cause-and-effect examples. Similarly, two mothers stimulate their children's curiosity by suggesting reading material, and one mother advises her child to consult teachers when in doubt. For example:

"I constantly tell my child that he should not be ashamed of asking questions, and I ensure that he communicates with others as much as possible."

"I want my child to talk about an event he experienced, I ask questions about him, and then I have him ask."

Conversely, in the perspective of mothers of gifted children, eight mothers emphasize the significance of children's questions as a means to cultivate their skill in inquiry, while seven mothers highlight their role in fostering the child's cognitive development. For two mothers, the importance lies in comprehending the child's mind world, and one mother sees questioning as a way to enhance the parent-child bond. Additionally, another mother perceives questions as a means to satisfy the child's curiosity. For example:

"The questions we ask may contain judgment, but there is no judgment in the questions asked by the child, and the child may approach the events in a different way. We have a pattern, and since we look at life from these patterns, the questions we ask are within the framework of these patterns. But the questions the child asks can be much more creative and much more meaningful regardless of the patterns. Therefore, it is precious for my child to ask questions so that he can learn to question independently of the patterns."

"The questions she asks reflect her mind world and will contribute to her cognitive development, so of course, it is important."

Analysing the strategies used by mothers of gifted children to stimulate their children's questioning, it is evident that eight mothers foster curiosity through engaging activities. Three mothers approach intriguing the child's mind to encourage independent investigation, while one mother employs games for encouragement. Additionally, a mother promotes questioning through family discussions on specific topics, and another engages her child with complex problems that demand comprehension, inquiry, and solution-finding. In contrast, three mothers don't undertake any explicit action to encourage their children's questions. For example:

"I usually keep it up when he asks me a question. For example, I do not directly answer the question he asks. I confuse his mind more, and I ask him to investigate. In this way, he researches more and asks more questions."

"I consciously tell him something that will arouse his curiosity, and he starts asking questions."

The findings highlight that mothers of typically developing children primarily view their children's questions as pivotal for comprehending their world and enhancing their learning. They perceive children's questions as windows into their children's perspectives and cognitive processes. Similarly, although a few mothers of gifted children also value the insight gained through their children's questions, most emphasize the role of questioning in nurturing their children's inquiry skills and cognitive development.

Theme 5: Mothers' Approach to Their Children's Responses

The final theme outlines how mothers of gifted and typically developing children engage with their children's responses and guide their interactions. Among the mothers of typically developing children, fifteen intervene in their children's responses to steer them towards what they believe to be accurate or truthful information, and two mothers intervene to enhance their children's understanding through illustrative examples. In contrast, five mothers refrained from directing their children's responses to preserve their imaginative realms, while three did not provide their perspectives. For example:

"I want my child to know the correct answer if the answer is wrong. Then I try to impose the truth on him based on my thoughts. I don't know how accurate that is."

"Yes, I usually intervene to teach the truth. Of course, these truths also include my thoughts."

Analysing the responses of the mothers of gifted children reveals that most of them refrain from intervening in their children's answers, thereby avoiding influencing their children's self-expression or identity. For example:

"I usually do not direct my child's answers in line with my thoughts, but such situations rarely occur without realizing it. The child can look at life more creatively and uniquely, so it would be wrong behaviour for me to restrict him. If I do not limit my child, he can find his identity or self. He will be able to have a more meaningful personality and express himself. Otherwise, he will turn into a person I create."

Similarly, five mothers, consistent with most mothers of typically developing children, guide their children's responses to accurate answers to prevent misconceptions. For example:

"When I am worried that my child is doing something wrong, I intervene in her answers and direct her by imposing my truths."

The findings show that mothers of typically developing children often shape answers according to their beliefs, aiming to convey their truth, on the other hand, most mothers of gifted children avoid interference, valuing their children's independent expressions.

DISCUSSION & CONCLUSION

This study reveals the similarities and differences between the questioning and responding strategies used by mothers of gifted and typically developing children towards their children. It first shows how mothers of gifted and typically developing children perceive the importance of asking questions and the purposes behind their questions. Most mothers of typically developing children attach importance to questioning to enhance their children's knowledge, teach unfamiliar concepts, and ensure lasting comprehension; mothers see questioning as important for developing social skills, self-expression, confidence, and communication for their children. On the other hand, most mothers of gifted children emphasize the importance of questioning in nurturing cognitive and thinking abilities, particularly problem-solving and critical thinking. Both groups acknowledge the importance of skill development, yet differences arise; mothers of gifted children prioritize cognitive abilities, whereas those with typically developing children place greater emphasis on learning skills. Cognitive and thinking skills

encompass essential mental processes for critical reasoning, higher-order thinking, and problem-solving (Ackerman, 2018; Anderson & Krathwohl, 2001; Facione, 2015), including knowledge analysis, synthesis, evaluation, and application. In contrast, learning skills (Weinstein et al., 2000; Zimmerman, 1990) focus on acquiring and applying knowledge, involving retention, study habits, and academic achievement. While distinguishing these aspects aids understanding, they often interact to support learning. Findings highlight the impact of cognitive emphasis among mothers of gifted children. Prioritizing these skills through questions may foster an environment where gifted children engage in advanced cognitive processes, integrating novel ideas. This early stimulation supports the learning journey of gifted children (Alexander et al., 2022; Schwartz et al., 2016; Vermette, 2009).

Notably, curiosity distinguishes the two mother groups despite both acknowledging the question's importance. For mothers of gifted children, encouraging curiosity is paramount in shaping their strategies. This aligns with existing research linking curiosity to giftedness (Colangelo, 2003; Clark, 2008). On the other hand, mothers of typically developing children see questions as satisfying existing curiosity, not cultivating it. Mothers of gifted children strive to enhance curiosity, fostering deeper interest. Conversely, mothers of typically developing children satisfy curiosity, quenching interest. Curiosity flourishes in children within a social context molded by those around them (Engel, 2011). Maternal questioning strategies at home, potentially fostering early-stage nurturing of gifted children's curiosity. Fostering a child's curiosity can profoundly influence their learning trajectory (Engel, 2011). Nonetheless, a thorough inquiry is required, prompting future studies to explore the influence of parental questioning strategies on shaping children's curiosity.

The study reveals that mothers of typically developing children primarily employ inference and interpretation question types in Wolf's (1987) question framework towards their children, whereas most mothers of gifted children prefer hypotheses and reflective question types. Mothers of gifted children use strategic questioning to cultivate an environment fostering advanced thinking skills. Utilizing targeted question types such as predictive, critical, reflective, and inquiry-based, these strategies offer early experiences that enhance cognitive abilities. While genetics influence cognitive development, parental interactions significantly shape it, especially questioning and responding, as discussed in the literature review at the beginning of the paper. These strategies challenge problem-solving, encourage critical thinking, and prompt higher-order cognitive engagement. Open-ended queries stimulate critical consideration of diverse viewpoints (Berk, 2008). Mothers of gifted children facilitate deep comprehension that transcends surface understanding by encouraging profound thought, enabling versatile knowledge interpretation and application.

Using Bronfenbrenner's (1986) eco-psychological model to analyse mothers' questioning techniques highlights the importance of mothers in children's development within the microsystem, which includes immediate interaction contexts. Children's cognitive abilities, such as critical thinking and problem-solving, are shaped by their mothers' queries, and their mothers' response techniques impact their communication skills. The mesosystem emphasises the mother's relationships with other influential figures, such as teachers and extended family, highlighting the linkages between diverse microsystems. Maternal strategies and messages impact cross-system communication, affecting child development. A mother's social networks and work environment might influence a mother's parenting methods within the ecosystem, including indirect factors. Positive work environments and support networks can enhance a mother's ability to interact effectively with her child. The macrosystem considers broader societal perspectives and cultural norms that may influence the questions and responses. The chronosystem highlights changes in development across time. As children grow, mothers modify their questions and ways they respond to meet their changing children's needs and abilities. These strategies may also be influenced by changes in family dynamics, like divorce, relocation, or resource availability. The microsystem, mesosystem, exosystem, macrosystem, and chronosystem are examined to show how these factors influence mothers' questioning and responding strategies, which in turn affects how their children develop. Based on Bronfenbrenner's (1986) framework, this ecological viewpoint emphasises the significance of a holistic family-oriented approach to child development. Additionally, Vygotsky's approach supports this perspective by acknowledging the social environment as a primary source of a child's development and emphasising the significance of interactions between the primary social environment and related external environments in fostering cognitive and psychological growth (Kirca Demirbaga, 2018).

According to the study, mothers of gifted and typically developing children show significant differences in their responding strategies. Mothers of typically developing children, on the other hand, mostly respond through examples. Mothers of gifted children respond by using cause-and-effect links and encourage their children to collaborate on responding. In other words, mothers of gifted children prioritise collaborative exploration and

causal knowledge. This interaction-based strategy may improve knowledge integration at home, which encourages analytical and critical thinking. The purposeful integration of knowledge and the effective use of informative answers contribute to children's cognitive development (Chouinard, 2007). These responding strategies, which mothers of gifted children use, may promote early cognitive development by fostering analytical reasoning, critical thinking, and coherent information integration. On the other hand, mothers of typically developing children mostly respond to their children's questions by providing examples and explanations. While some of these mothers have a tendency to stop their children's questions or respond succinctly "yes" or "no", mothers of gifted children do not exhibit these strategies. This demonstrates that the mothers of typically developing children prioritize direct, clear explanations and tangible examples to facilitate their children's understanding of concepts quickly.

According to the study, the mothers of typically developing children believe that their children's questions are crucial to understanding their world and fostering learning. They see these questions as windows into their children's thoughts and viewpoints. However, most mothers of gifted children stress the value of questioning in fostering inquiry skills and cognitive development, even though some mothers emphasize the importance of children's questions in terms of understanding their children's world. Recognizing and acknowledging children's thoughts, feelings, and inquiries are integral to responsive strategies (Bornstein, 2015). Mothers stimulate further inquiry and learning by validating their children's cognitive endeavours and offering meaningful responses. Active and responsive dialogues with children contribute to language development, which is closely connected to cognitive abilities (Huttenlocher et al., 2002). Children exposed to rich verbal interactions with caregivers generally exhibit enhanced cognitive outcomes (Weizman & Snow, 2001). Mothers who frequently pose diverse questions, respond supportively, and engage in substantial verbal exchanges with their children aid their cognitive growth (Berk, 2008; Huttenlocher et al., 2002). From an ecological perspective on giftedness, it's feasible that gifted children gain from an enriched home environment influenced by skilled maternal questioning and responding. This early nurturing can stimulate cognitive development and learning, laying a strong groundwork for gifted individuals.

For children's questions to optimally contribute to cognitive development, they must be geared toward seeking information and driven by intrinsic curiosity rather than attention-seeking (Chouinard, 2007). The relevance of their inquiries should directly pertain to cognitive development processes and content. In essence, children should acquire the ability to extract information and generate predictions that propel the meaningful progression of foundational conceptual frameworks (Chouinard, 2007). This highlights an interactive relationship between children's questions and maternal responding styles. The findings emphasize the pivotal role of parental encouragement in nurturing children's questioning skills. Findings reveal diverse maternal motivations and approaches for encouraging children's questions. Remarkably, most mothers of typically developing children mentioned no specific efforts, suggesting a potential opportunity for cultivating curiosity and learning. Interventions or strategies to promote a questioning culture could be valuable. On the other hand, most mothers of gifted children prioritize nurturing curiosity, with a few exceptions.

The study reveals both similarities and differences in the responses of the two groups of mothers regarding their involvement in their children's answers. Despite differing motivations, some mothers in both groups tend to intervene based on their perception of truth. While a few mothers of gifted children intervene to prevent inaccuracies or mistakes, most mothers of typically developing children acknowledge intervening to guide their children towards what they consider the truth. The results also underscore a clear distinction in the approaches of mothers in each group. Mothers of typically developing children often shape responses based on their beliefs to convey their own perspectives. Maternal truth may impede autonomy and self-worth, potentially inhibiting the development of independent responses (Maker & Nielson, 1996). On the other hand, most mothers of gifted children avoid interference, prioritizing the cultivation of their children's independent expressions. Most mothers of gifted children acknowledge the significance of each child's response as a unique perspective, enriching their relationships. By abstaining from imposing their beliefs and intervening in responses, these mothers can cultivate an environment that respects individuality, facilitates response development (Maker & Nielson, 1996), and nurtures self-assured expression of thoughts (Grolnick et al., 1991; Maker & Nielson, 1996). This aligns with nurturing cognitive and creative abilities in gifted children, validating their viewpoints and bolstering intellectual development (Silverman, 1993). Enabling gifted children to express themselves autonomously fosters critical thinking, articulate expression, and meaningful engagement (Walker, 2002). However, comprehensive research is needed to explore the potential impact of mothers' response approaches on children's development.

In conclusion, this study unravels distinctive patterns in questioning and responding strategies used by mothers of gifted and typically developing children. The study contributes to the ecological aspect of giftedness

studies, considering the influence of various systems on maternal strategies and, consequently, on children's development. The findings underscore the significance of maternal influences on children's cognitive development and encourage further exploration of the intricate dynamics between parental strategies and children's development. This research contributes insights to the broader understanding of nurturing cognitive skills, curiosity, and individual expression within the family context, opening avenues for future investigations into the nuanced interplay between maternal strategies and children's developmental trajectories.

Limitations of the Study and Future Research

While offering valuable insights into maternal questioning and responding strategies, the study acknowledges certain limitations that warrant consideration. The reliance on interviews as the sole data collection method, though providing in-depth perspectives, may limit the breadth of the data. Future research endeavours might benefit from employing diverse data collection methods to offer a more comprehensive understanding. The study also recognizes the need for a broader and more diverse participant pool to enhance the representativeness of results. It is essential to note the cultural homogeneity of the study, focused exclusively on Turkish participants, highlighting the importance of conducting similar research across diverse cultural backgrounds to enhance the generalizability of findings.

The aim of this study was to compare the questioning and responding strategies of mothers of gifted and typically developing children, rather than to investigate the origin of the differences in the strategies of both groups of mothers. Thus, this limitation doesn't diminish the findings and might foster new research. The study acknowledges variations in education levels among mothers and emphasizes the need for future studies to explicitly explore the correlation between parental educational backgrounds and questioning practices. This could involve examining how education impacts question types, discussion depth, and cognitive stimulation. Further inquiry is needed to grasp the mutual impact of mothers' responses and children's encouragement to pose specific questions. Despite these limitations, the study provides valuable findings on the differences in the questioning and responding strategies of mothers of gifted and typically developing children. The results may inspire future research by contributing to a more comprehensive understanding of the effects of these strategies of mothers on children's cognitive development.

Statements of Publication Ethics

Ethical permission of the research was approved by Yıldız Technical University Social and Human Sciences Research Ethics Committee's decision dated 02/05/2022. The ethics committee document number is 2022.05.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Author 1	☒	☒	☐	☒	☒	☒
Author 2	☒	☐	☒	☒	☐	☐

Conflict of Interest

There are no conflicts of interest in this study.

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APPENDIX A

Interview Questions

1. What is the importance of asking questions for your child's development?

2. For what purpose(s) do you ask your child questions?

3. How do you structure the questions you ask your child? Or what kind of questions do you use when asking your child a question? Could you explain with examples?

4. When your child asks you a question, how do you respond to him/her?

5. What do you do when you don't know the answer to your child's questions?

6. What is the importance of responding to your child's questions?

7. Would you encourage your child to ask questions? If so, how do you do this, can you explain with examples?

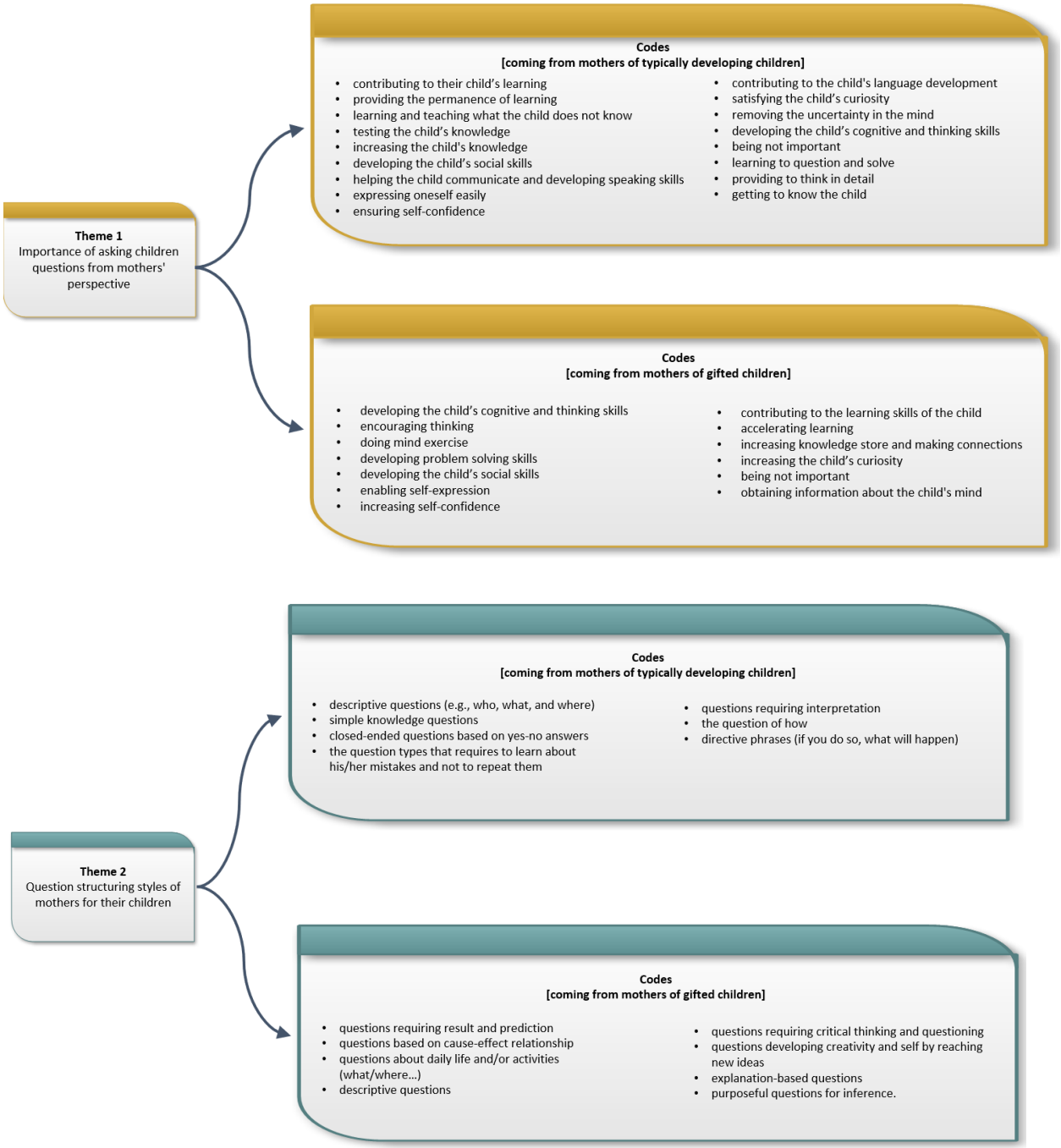
8. Why your child's questions are important or not?

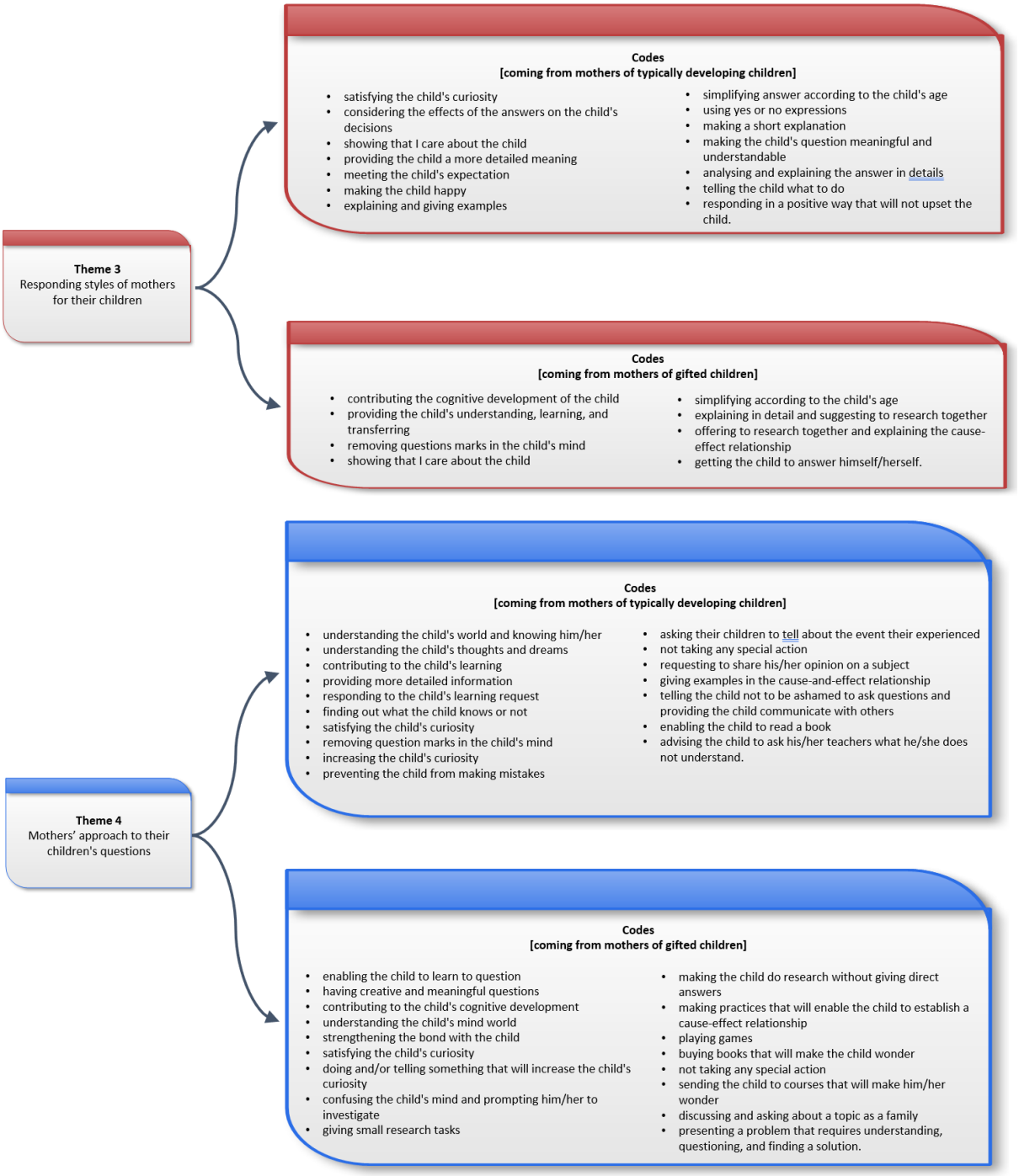
9. Do you interfere with your children's responds? If so, how do you do that?

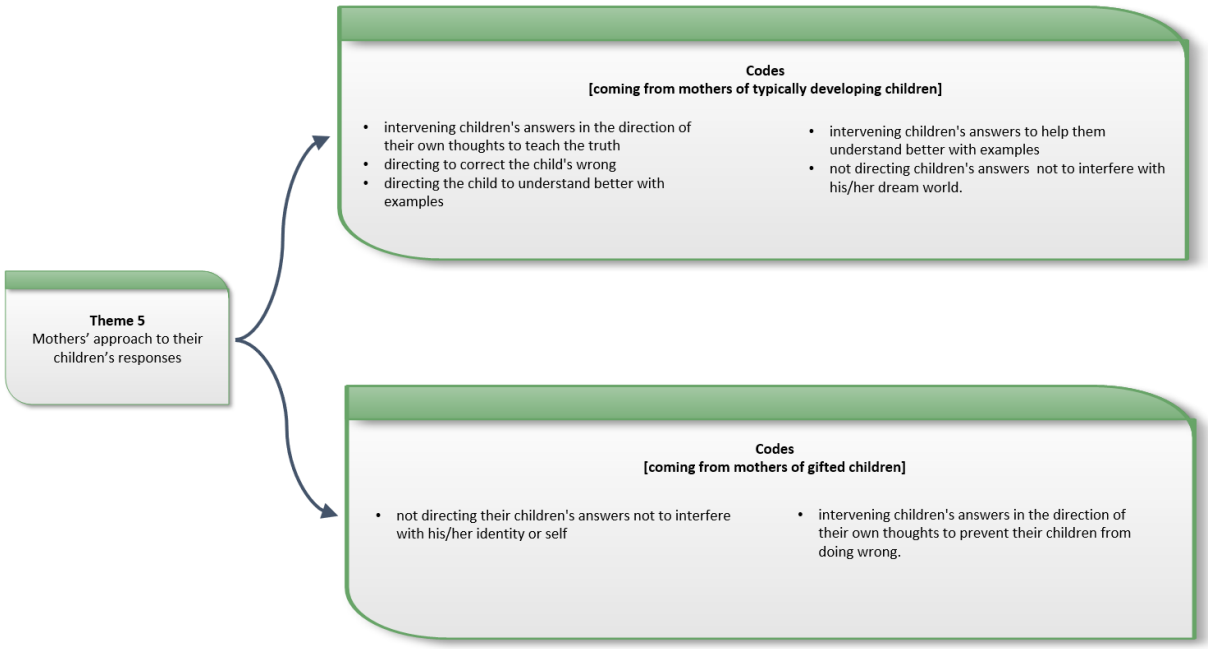
10. Is there anything you would like to add to this topic?

APPENDIX B

Thematic Map of the Codes




Theme 3
Responding styles of mothers for their children
Codes
[coming from mothers of typically developing children]
satisfying the child's curiosity
considering the effects of the answers on the child's decisions
showing that I care about the child
providing the child a more detailed meaning
meeting the child's expectation
making the child happy
explaining and giving examples
simplifying answer according to the child's age
using yes or no expressions
making a short explanation
making the child's question meaningful and understandable
analysing and explaining the answer in details
telling the child what to do
responding in a positive way that will not upset the child.
Codes
[coming from mothers of gifted children]
contributing the cognitive development of the child
providing the child's understanding, learning, and transferring
removing questions marks in the child's mind
showing that I care about the child
simplifying according to the child's age
explaining in detail and suggesting to research together
offering to research together and explaining the cause-effect relationship
getting the child to answer himself/herself.
Theme 4
Mothers' approach to their children's questions
Codes
[coming from mothers of typically developing children]
understanding the child's world and knowing him/her
understanding the child's thoughts and dreams
contributing to the child's learning
providing more detailed information
responding to the child's learning request
finding out what the child knows or not
satisfying the child's curiosity
removing question marks in the child's mind
increasing the child's curiosity
preventing the child from making mistakes
asking their children to tell about the event their experienced
not taking any special action
requesting to share his/her opinion on a subject
giving examples in the cause-and-effect relationship
telling the child not to be ashamed to ask questions and providing the child communicate with others
enabling the child to read a book
advising the child to ask his/her teachers what he/she does not understand.
Codes
[coming from mothers of gifted children]
enabling the child to learn to question
having creative and meaningful questions
contributing to the child's cognitive development
understanding the child's mind world
strengthening the bond with the child
satisfying the child's curiosity
doing and/or telling something that will increase the child's curiosity
confusing the child's mind and prompting him/her to investigate
giving small research tasks
making the child do research without giving direct answers
making practices that will enable the child to establish a cause-effect relationship
playing games
buying books that will make the child wonder
not taking any special action
sending the child to courses that will make him/her wonder
discussing and asking about a topic as a family
presenting a problem that requires understanding, questioning, and finding a solution.


Theme 5
Mothers' approach to their children's responses
Codes
[coming from mothers of typically developing children]
intervening children's answers in the direction of their own thoughts to teach the truth
directing to correct the child's wrong
directing the child to understand better with examples
intervening children's answers to help them understand better with examples
not directing children's answers not to interfere with his/her dream world.
Codes
[coming from mothers of gifted children]
not directing their children's answers not to interfere with his/her identity or self
intervening children's answers in the direction of their own thoughts to prevent their children from doing wrong.

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A General Overview of Studies on Authentic Leadership (1978-2022): A Bibliometric Analysis

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Abstract

This study aims to examine studies on authentic leadership published in WoS indices between 1978 and 2022 utilising the bibliometric analysis method. Research data were retrieved from papers on authentic leadership using the WoS Core Collection database. Of the papers, 1,483 that met the study's inclusion criteria were examined via descriptive and bibliometric analysis methods. Based on descriptive analysis methods, we established that there was a general increase in the number of studies on authentic leadership except for 2022, and 2021 saw the highest number of papers, papers were published in Leadership Quarterly the most, the country that published the most papers was the USA, and that these papers were written mainly in the English language. When analysing the bibliometric analysis results and based on citation analysis, the most attributed author, paper, journal, and institution on authentic leadership were William L. Gardner, Authentic Leadership: Development and Validation of a Theory-Based Measure, Leadership Quarterly, University of Nebraska, respectively. Regarding co-authorship analysis, Lucas Monzani and Rolf van Dick as authors, the Catholic University of Leuven as the institution, and the United States of America as the country had higher link strengths. We found in the co-concept (keyword) analysis that the most repeated concepts were authentic leadership and leadership concepts, respectively, and some current concepts on authentic leadership in recent years were COVID-19, meta-analysis, subjective well-being, administration, information exchange, self-sufficiency, employee creativity, and organisational citizenship.

Keywords: Authentic leadership, bibliometric analysis, citation analysis, co-authorship analysis, co-concept (keyword) analysis.

Otantik Liderliğe İlişkin Çalışmaların Genel Görünümü (1978-2022): Bibliyometrik Bir Analiz

Öz

Bu araştırma otantik liderlikle ilgili 1978-2022 yılları arasında WoS indekslerinde yayımlanan makaleleri bibliyometrik analiz yöntemiyle incelemeyi amaçlamaktadır. Araştırmanın verileri WoS Core Collection veri tabanı kullanılarak otantik liderlik konulu makalelerden elde edilmiştir. Araştırmanın dâhil etme ölçütlerini karşılayan 1483 makale betimsel analiz ve bibliyometrik analiz yöntemleriyle incelenmiştir. Betimsel analiz sonuçlarına göre otantik liderlik konulu makalelerin sayısında 2022 yılı dışında genel olarak bir artış olduğu ve en çok 2021 yılında makale yazıldığı, en çok Leadership Quarterly dergisinde makale yayımlandığı, en çok yayın yapan ülkenin Amerika Birleşik Devletleri olduğu ve makalelerin büyük ölçüde İngilizce dilinde kaleme alındığı belirlenmiştir. Bibliyometrik analiz sonuçları incelendiğinde ise atıf analizine göre otantik liderlikle ilgili en çok atıf alan yazarın, makalenin, derginin ve kurumun sırasıyla William L. Gardner, Authentic Leadership: Development and Validation of a Theory-Based Measure, Leadership Quarterly başlıklı makale ile Nebraska Üniversitesinin olduğu tespit edilmiştir. Ortak yazar analizi bağlamında yazar olarak Lucas Monzani'nin ve Rolf van Dick'in, kurum olarak Leuven Katolik Üniversitesinin, ülke olarak Amerika Birleşik Devletlerinin bağlantı güçlerinin daha yüksek olduğu görülmüştür. Ortak kavram (kelime) ağ analizinde en çok tekrarlanan kavramların sırasıyla otantik liderlik ve liderlik kavramları olduğu, son yıllarda otantik liderlikle ilgili güncel kavramların ise COVID-19, meta-analiz, öznel iyi oluş, yönetim, bilgi paylaşımı, öz-yeterlilik, çalışan yaratıcılığı ve örgütsel vatandaşlık gibi kavramlar olduğu belirlenmiştir.

Anahtar kelimeler: Otantik liderlik, bibliyometrik Analiz, atıf analizi, ortak yazar analizi, ortak kavram (kelime) analizi.

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INTRODUCTION

The concepts of leader and leadership have been leading concepts that were vastly discussed and on which numerous studies were conducted (Northouse, 2007; Yardibi, 2012). However, the recent increase in competition and global developments fundamentally changed the classical leaders and leadership approaches (Erçetin, 2000). A significant number of crises and adverse events that occurred in organisational life around the globe also damaged employees' trust towards each other and their leaders. In other words, crises and issues encountered in organisations increased the need for leaders who were on the level with everyone and adopted honesty as a principle (Avolio et al., 2004; George et al., 2007). On the other hand, empirical and theoretical studies on positive psychology guided researchers towards positive leadership rather than conventional and classic leadership approaches (Ilies et al., 2005). With the impact of modern and contemporary approaches, new and up-to-date leadership styles surfaced, and different meanings were attributed to concepts of leadership (Fry, 2003). In this respect, the authentic leadership approach is among the modern and contemporary leadership paradigms that attach importance to the leader's sincerity, transparency, and ability to demonstrate ethical behaviours (Wang et al., 2014).

Authentic leadership is referred to as having the potential to affect numerous positive or negative variables in organisations (Alvesson & Sveningsson, 2013; Peterson et al., 2012). For instance, authentic leadership may ensure that each employee grows in line with their capacity (Alilyyani et al., 2018), establishing a self-awareness consciousness (Bryan & Blackman, 2019), developing an internalised moral perspective (Rego et al., 2014), respecting the opinions of others (Bryan & Vitello-Cicciu, 2020), providing the organisation with sufficient resources and energy (Wang et al., 2021), and bettering individual performance (Daraba et al., 2021; Lee et al., 2020; Qiu et al., 2019). In addition, authentic leadership may enhance organisational performance (Duarte et al., 2021; Shamir & Eilam, 2005; Zhu et al., 2011), organisational loyalty (Peus et al., 2012; Schaubroeck et al., 2017), confidential relationship (Laschinger et al., 2013; Maximo et al., 2019), organisational productivity (Avolio et al., 2004), leader-member exchange (Jung et al., 2021), job satisfaction (Wirawan et al., 2020), positive organisational climate (Hsiung et al., 2012), organisational citizenship (Wei et al., 2018), and organisational support (Aydın, 2015; Gül et al., 2017; Zbierowska, 2019), it may also reduce unwanted negative behaviours in organisations (Jang & Kim, 2021; Monzani et al., 2021; Ribero et al., 2020). In other words, authentic leaders positively affect employees, contribute to organisational development, reinforce exchange links between employees, and support employees in performing duties that suit their talents (Çeri-Booms, 2009; Marques-Quinteiro et al., 2021). Authentic leaders also contribute to the personal development of others by displaying consistent and accurate leadership behaviours (Luthans & Avolio, 2003).

In literature, research on authentic leadership generally aims to establish the correlation between authentic leadership and various variables. In this context, there exist numerous emprical research in literature that investigate the correlation between authentic leadership and organisational climate (Kim et al., 2019), individual achievement (Wang et al., 2014), organisational citizenship (Joo & Jo, 2017), information exchange (Besen et al., 2017; Javaid et al., 2018; Tran, 2019), cooperation (Zeb et al., 2019), entrepreneurship (Attar & Çetinkaya, 2020), turnover intention (Ahmad & Kuang, 2018; Oh & Oh, 2017), organisational support (Aria et al., 2019; Baykal, 2020; Chang et al., 2020; Hu & Ma, 2016), organisational silence (Avey et al., 2012; Knoll & van Dick, 2013), job satisfaction (Choi & Ahn, 2016; Darvish & Rezaei, 2011; Wirawan et al., 2020), organisational justice (Kılıç, 2020), organisational commitment (Pittinsky & Tyson, 2005; Meskelis & Whittington, 2020), psychological capital (De Hoogh & Den Hartog, 2008; Luthans & Youssef, 2004), innovative work behaviours (Cerne et al., 2013; Niu et al., 2018), and emotional exhaustion (Laschinger & Fida, 2014). Additionally, there have recently been extensive theoretical (Arda et al., 2016; Avolio & Gardner, 2005; Baykal, 2017; Dirik & Seren İntepeler, 2019; Gardner et al., 2011; Goorge et al., 2007; Shamir & Eliam, 2005; Terzi Çoban & Tutar, 2020; Yetgin, 2020) and systematic review studies (Akyürek, 2021; Alilyyani et al., 2018; do Valle et al., 2021; Gardner et al., 2011; Henry, 2022; Malila et al., 2018; Margiadi & Wibowo, 2020; Maziero et al., 2020; Milic, 2013; Zhang et al., 2022) on authentic leadership in literature. However, most of these studies were found to have focused on a particular area or a topic of authentic leadership, or they were limited to descriptive analyses that demonstrate a certain tendency toward authentic leadership. In addition, in the literature, we have not encountered studies that tackle all the relevant studies as a whole and investigate with the help of bibliometric and scientific mapping analyses, even though such studies on authentic leadership demonstrate a variety and present a rich knowledge. Thus, the current study may be deemed vital since it puts forth the general tendency and status of studies on authentic leadership conducted between 1978 and 2022 reviewed in Web of Science (WoS) indices with the help of bibliometric and

scientific mapping analyses. We also assume that the study may contribute to the planning of research to be conducted in the future on authentic leadership, determining their general structure, and understanding the historical course. To this end, the main aim of this study is to examine the studies on authentic leadership published in WoS between 1978 and 2022 via the bibliometric analysis method.

Literature Review

The foundations of authenticity date back to Greek philosophy, and as a definition, it means principles and values that are true or correct (Müceldili et al., 2013; Novicevic et al., 2006). The theory of authenticity, which emphasises the significance of self-knowledge, is noted to have had an impact on Abraham Maslow's hierarchy of needs theory (Covelli & Mason, 2017). The authenticity theory within the leadership framework emphasises the individual knowing their strong and weak aspects and their internalising moral principles and values. For this reason, authentic leadership is mainly evaluated as a leadership approach closely related to charismatic, transformational, and servant leadership approaches (Avolio & Gardner, 2005). First introduced to the literature by Luthans and Avolio (2003) as an up-to-date leadership style, authentic leadership is, in the general sense, the ability of the organisation leader to affect organisation members with a high and quality moral perspective on the basis of honesty (Avolio et al., 2004). Authentic leadership also means that the leader should be coherent in their actions and discourse (Goffe & Jones, 2005), be transparent, optimistic, hopeful, and future-oriented (May et al., 2003), treat all their employees under social justice and equality principles (Michie & Gooty, 2005), interact with fellow organisation members with mutual trust and sincerity (George et al., 2007), support employees and focus on their strengths (Wherry, 2012), and provide others with confidence with their beliefs, acceptances, and principles (Robbins & Judge, 2012). Therefore, the authentic leadership approach consists of demonstrating leadership free from imitation and based on one's beliefs, acting in keeping with adopted values, knowing oneself, keeping natural, and preserving one's authenticity (McShane & Glinov, 2016).

Various research exists in the literature on authentic leadership's meaning and (or) its sub-dimensions (Gardner et al., 2005; Ilies et al., 2005; Kernis, 2003). However, authentic leadership is analysed the most in the light of the "self-awareness, internalised moral perspective, processing information in a balanced and impartial manner, and relational transparency" sub-dimensions that surfaced as a result of the study conducted by Walumbvwa et al. (2008). Self-awareness is one's cognisance of their potential or their strengths and weaknesses. Self-awareness comprises one's knowing or assessing themselves in addition to one's assessment by others (Sturn et al., 2014). The internalised moral perspective sub-dimension of authentic leadership points to the process of considering and adopting moral values (Senjana et al., 2016). An authentic leader with an internalised moral perspective never compromises their strong moral standards, even in the most challenging cases (Ahmad et al., 2015; Wu & Chen, 2019). The balanced and impartial processing of information is achieved by leaders transforming the information they obtain in many ways into an appropriate form as it is and without contorting (Corner, 2015). Authentic leaders objectively analyse and evaluate all the data they obtain before they make a decision (Mortier et al., 2016). Lastly, the relational transparency sub-dimension of authentic leadership is defined as authentic leaders' ability to present their emotions and opinions transparently and confidentially (Tabak et al., 2012). Authentic leaders with relational transparency create a positive climate in the organisation and eliminate the barriers blocking employee support (Nelson et al., 2014). Within this framework, it is understood that self-awareness is about one's knowing themselves and awareness of their potential, acting in line with the internalised honesty principle of moral perspective as well as moral standards, processing information in a balanced and impartial manner, and objectively analysing the obtained information and that the relational transparency sub-dimension is about being straightforward, realistic, and cognisable.

Authentic leaders are accepted as positive role models by the employees of the organisation. In other words, authentic leaders are constructive and positive in their relations with organisation members (Gardner et al. 2005). This characteristic of authentic leaders can also impact employees' perspectives on the organisation itself. For instance, the more authentic leadership behaviours are demonstrated or shown to increase in an organisation, the more upward tendency will occur in the levels of happiness (Jensen & Luthans, 2006), trust in the organisation (Jung et al., 2009; Koşar & Yalçınkaya, 2013), and organisational citizenship behaviours (Dilek, 2005; Hirst et al., 2016) in addition to leader effectiveness (Erkutlu, 2008; Hoffman et al., 2013; Menon, 2014). As a matter of fact, authentic leadership was reported to have an impact on organisational citizenship, organisational commitment, job satisfaction, and organisational performance (Bakari et al., 2019; Hanaysha et al., 2022; Ribeiro et al., 2020; Shapira-Lishchinsky and Tsemach, 2014; Wong et al., 2020) supports this inference. Essentially, authentic leadership does not just ensure an increase in positive behaviours in organisations; it also allows organisation members to imitate their leaders (Lyubovnikova et al., 2017). The foundation of authentic leaders

being imitated lies not in adopting a commanding attitude but in motivating their employees (Lawler & Ashman, 2012). For this reason, it is possible to witness authentic leadership as a leadership approach increasingly gaining importance and popularity in organisations and business life (Shang et al., 2019).

Research Questions

Authentic leadership, considered to be one of the most prominent and noteworthy types of leadership in the last two decades (Avolio & Gardner, 2005; Walumbwa et al., 2008), has in a short time gained a significant place in the literature due to its impact on organisational behaviour (Avolio & Mhatre, 2012; Branson, 2007; Cameron et al., 2003; Diddams & Chang, 2012; Luthans & Avolio, 2003). According to Begley (2001), authentic leadership has attracted the attention of researchers due to its potential for positive outcomes in organisational life and its potential to create synergy in organisations. Similarly, Crawford et al. (2020) emphasise the importance of authentic leadership in motivating organisational members and acting with ethical principles. On the other hand, Ahmed (2023) states that authentic leadership increases the trust, satisfaction, and performance of the members of the organisation and enables them to believe that the organisation's successes are not unrequited (Ahmed, 2023). Numerous studies in the literature also indicate that authentic leadership leads to positive outcomes in organisations (Fox et al., 2015; Kulophas et al., 2018; Roncesvalles & Gaerlan, 2021; Shapira-Lishchinsky & Tsemach, 2014; Shie & Chang, 2022; Tsemach & Barth, 2023; Zhang et al., 2022), reports that it prevents negative outcomes (Boz, 2016; Ismail et al., 2019; Jang & Kim, 2021; Monzani et al., 2021; Ribero et al., 2020; Tsemach & Barth, 2023). All of these studies support authentic leadership theory, which emphasises that authentic leadership has a positive effect on the behaviours and attitudes of organisational employees (Avolio et al., 2004). However, despite the impact of authentic leadership on various organisational behaviours, it is reported that there are very few systematic studies on authentic leadership (Ahmed, 2023). In this direction, Gardner et al. (2011) reviewed articles published in different disciplines, Alilyyani et al. (2018) reviewed the antecedents, mediators and outcomes of authentic leadership in health services, and Ahmed (2023) reviewed the antecedents, mediators and outcomes of authentic leadership in educational organisations. The above studies are mainly from a single field and are descriptive in nature. Therefore, it is understood that there is a need to examine the studies conducted in all fields related to authentic leadership and to determine the connection and general structure between the studies. It is believed that the current study meets this need as it addresses authentic leadership without limiting it to a single field and reveals the general view of authentic leadership regardless of the field. In this context, the research aims to examine the studies published on authentic leadership in WoS indexes between 1978-2022 via the bibliometric analysis method. This study also sought answers to the questions below:

1. What type of distribution do publication years of studies included in the study demonstrate?
2. Which journals published the studies on authentic leadership the most?
3. Which countries created the most publications on authentic leadership?
4. What is the distribution of studies on authentic leadership based on the languages in which they were published?
5. Which are (the most cited) authors, studies, journals, and institutions on authentic leadership?
6. What kind of cooperation exists between authors, institutions, and countries that publish on authentic leadership?
7. What are the most studied subjects (concepts) on authentic leadership?

METHOD

This research analysed studies on authentic leadership reviewed in WoS and dated between 1978 and 2022 using the bibliometric analysis method. Bibliometric analysis denotes the analysis of studies conducted in a particular area using a set of techniques using databases (Pan et al., 2019). To put it in another way, bibliometric analysis is measuring scientific elements in a particular field, transforming them into statistical outputs, and analysing the changes or developments of the correlation between these elements in the face of time (Cahawla & Goyal, 2022; Hernandez-Torrano et al., 2020). The bibliometric analysis aims to summarise any field's general tendency, knowledge accumulation, and changes throughout the years via statistical data and visual mapping techniques (Donthu et al., 2021; Merigo & Yang, 2017). Since this study also aimed to determine the general tendency of studies on authentic leadership published between 1978 and 2022 in WoS, using fundamental analysis techniques, and to put forth their total and systematic appearance, we opted for the bibliometric analysis method.

Data Collection

Research data were retrieved from papers on authentic leadership using the WoS Core Collection database. Since the first paper was published in the Wos Core Collection database in 1978, the time interval of this study was established as 1978-2022. In selecting the WoS Core Collection database for this study, the WoS being an up-to-date database, harbouring numerous scientific journals, and ensuring the availability of the very first studies due to its archive dating way back (Falagas et al., 2008) has been effective. The studies to be included in the analyses were selected due to such criteria as them being research or review-style articles published between 1978 and 2022 and containing the subject of authentic leadership. This study did not apply source country, field of study, index, language, and starting year filters. Studies other than research and review articles (book chapters, editor articles, summaries of meetings, conference booklets, etc.) were excluded from the study. While collecting the analyses, the keyword "authentic leader*" was used in the "topic" menu to search within the title, abstract, and keyword to carry out scanning. As a result of the general review carried out on WoS on authentic leadership between 1978 and 2022 with no filter applied, a total of 1,856 studies were found, and resulting from the review taking into consideration the research measures, 1,483 studies were reached. In this regard, the flow diagram of this research was determined according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow model suggested by Moher et al. (2009) and is shown in Figure 1.

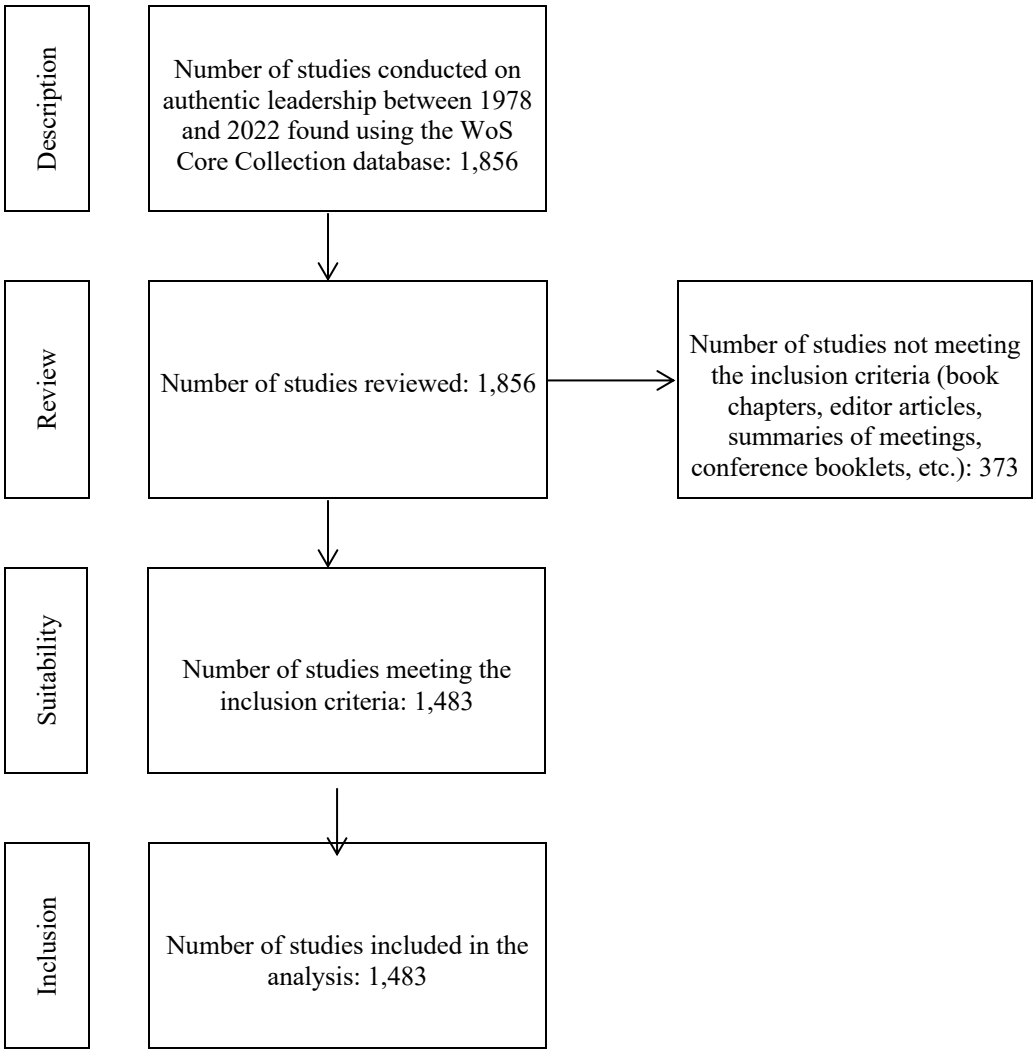

Figure 1. *PRISMA flow diagram of the research process*

Data Analysis

Two types of analysis were used in the study, namely, descriptive analysis and bibliometric analysis. Descriptive analysis results were obtained using the data presented by the WoS Core Collection database. Bibliometric analyses, however, were carried out using the VOSviewer 1.6.19 software package that allows for visual mapping. Dimensions of circles produced by the VOSviewer software package are represented with fonts and clusters with colours, and the distance between two circles symbolises the strength of similarity and

correlation. In other words, VOSviewer analysis software is a distance-based programme, and circles closer to each other pose a higher degree of correlation than those with longer distances (Robertson et al., 2020). A comprehensive analysis of the 1,483 studies retrieved from the WoS Core Collection database was conducted using a suite of bibliometric analysis techniques, including citation analysis, co-author analysis, co-citation analysis, and co-word analysis. Below are descriptions of the bibliometric analysis techniques used within the scope of this research:

Citation analysis: Citation analysis is a bibliometric analysis technique used to measure the effect and significance of studies considering the citations they receive. Citation analysis provides insight into the impact strength of the studies conducted in a particular field (Marx and Bornmann, 2016). The most cited studies, journals, institutions, and authors are determined in the citation analysis (Allam et al., 2021). This research further utilised citation analysis to ascertain the impact and significance of articles on authentic leadership.

Co-author analysis: Co-author analysis states the network created by more than one author cooperating on a study. Co-author analysis reflects the resulting cooperation (Acedo et al., 2006). Co-author analysis was used to establish the type of cooperation in the studies that were examined.

Co-citation analysis: Co-citation analysis depicts the citation of two studies and the correlation between these two studies. Co-citation analysis reveals the intellectual structure of the field (van Eck and Waltman, 2022). Co-citation analysis was used since the current study aims to establish the intellectual structure of authentic leadership.

Co-word analysis: Co-word analysis probes the correlation between words or concepts used in studies in a given field. Co-word analysis ascertains the most studied concepts or topics in a particular field (Zupic & Cater, 2015). This study, too, opted for co-word analysis to determine the prevalent study topics on authentic leadership.

Research Ethics

Since this is a bibliometric study, it does not require approval from the ethics committee.

FINDINGS

Findings of Descriptive Analysis

Within the descriptive analysis of the research, the distribution of papers on authentic leadership published from 1978 to 2022 was examined based on various parameters, including the years of publication, the journals in which they were published, the countries of origin, and the languages used in these publications. The distribution of articles accordingly included in this study is shown in Figure 2.

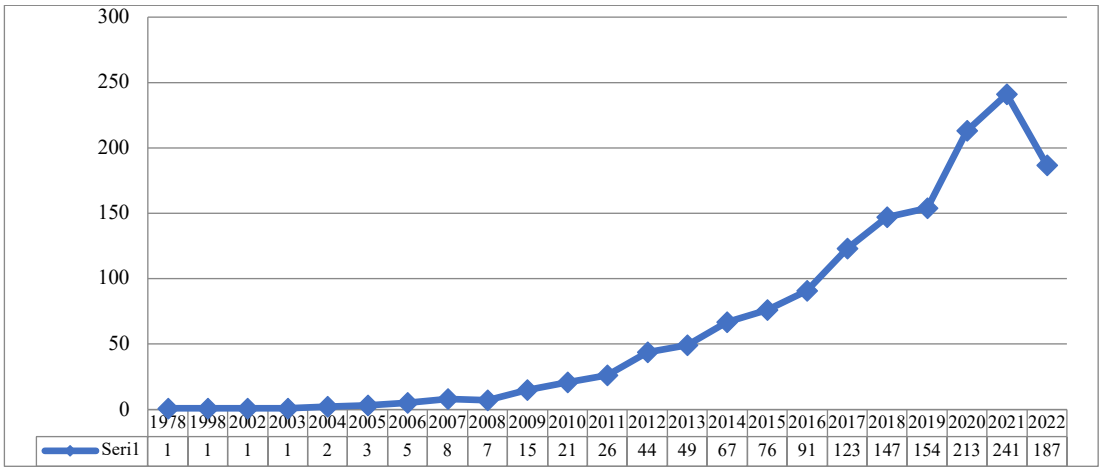

Figure 2. *Distribution of papers included in the research based on years*

As can be observed in Figure 2, the first paper on authentic leadership was published in 1978, and 2021 (n=241, 16.3%) witnessed the highest number of papers. There was also a constant periodic rise in the number of papers on authentic leadership from 1978 to 2021. However, 2022 saw a 22.41% decrease in the number of papers compared to 2021, dropping to 187. Although, in Figure 2, a drop can be observed in the number of papers on authentic leadership in 2022, when evaluated as a whole, it is observed that the interest in authentic leadership in the literature is generally in an upward tendency.

Table 1 shows the journals in which 1,483 articles on authentic leadership were published the most between 1978 and 2022.

Table 1. Journal Distribution of Articles

Name of the Journal*	n	%
Leadership Quarterly	71	4.79
Leadership Organization Development Journal	62	4.18
Frontiers in Psychology	55	3.71
Journal of Business Ethics	53	3.57
Journal of Nursing Management	42	2.83
Leadership	39	2.63
Sustainability	27	1.82
Journal of Leadership Organisational Studies	22	1.48
Journal of Management Development	22	1.48
Journal of Leadership Studies	21	1.42
Journal of Nursing Administration	17	1.15
Leadership in Health Services	16	1.08
Advances in Developing Human Resources	14	0.94
Journal of Advanced Nursing	14	0.94
International Journal of Environmental Research and Public Health	13	0.88
International Journal of Contemporary Hospitality Management	12	0.81
Sage Open	12	0.81
International Journal of Productivity and Performance Management	11	0.74
Public Relations Review	11	0.74
International Journal of Organizational Analysis	10	0.67
Journal of Organizational Behavior	10	0.67
Sa Journal of Industrial Psychology	10	0.67
European Journal of Work and Organizational Psychology	9	0.61
International Journal of Educational Management	9	0.61
International Journal of Nursing Studies	9	0.61

*Due to the large number of journals, the first 25 journals that published the most articles are reported in the table.

As illustrated in Table 1, Leadership Quarterly (n=71, 4.799%) leads with the highest number of published articles on authentic leadership between 1978 and 2022. This journal is followed by Leadership Organization Development Journal (n=62, 4.18%), Frontiers in Psychology (n=55, 3.71%), Journal of Business Ethics (n=53, 3.57%), Journal of Nursing Management (n=42, 2.83%), and Leadership (n=39, 2.63%). In other words, research on authentic leadership predominantly appears in interdisciplinary journals in various fields such as leadership, organisation, management, health and psychology.

Figure 3 displays the countries with the highest number of publications among 1,483 articles on authentic leadership between 1978 and 2022.

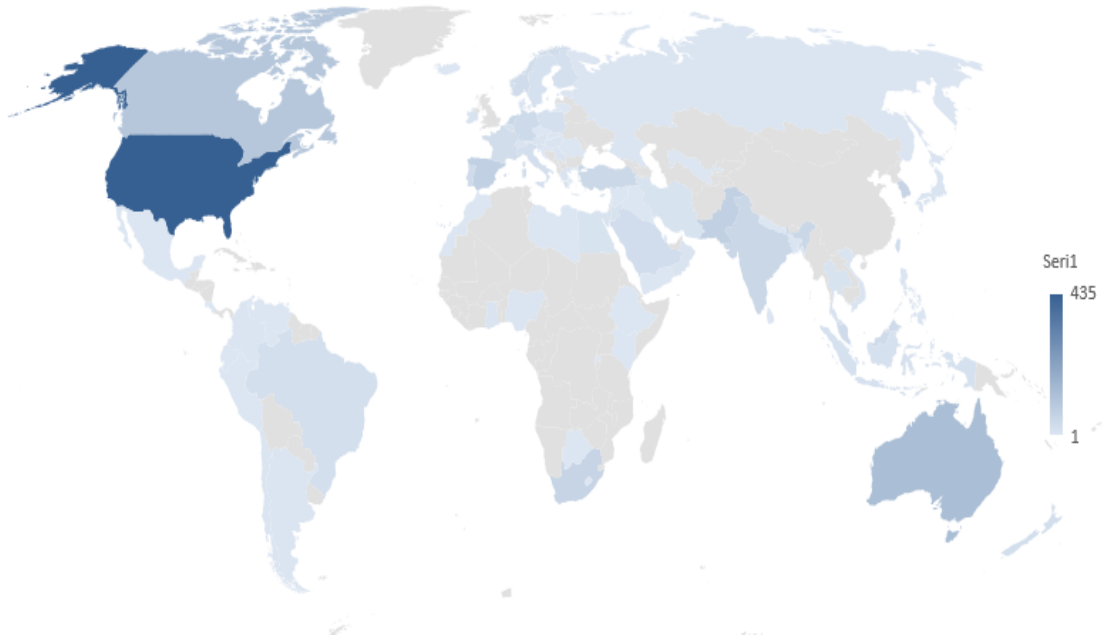

Figure 3. *Distribution of articles by country*

As seen in Figure 3, the number of articles on authentic leadership by country increases depending on the depth of the blue colour. When the distribution of articles by country is analysed in more detail, we found that the top five countries that published the most articles on authentic leadership between 1978 and 2022 were the USA (n=435, 29.33%), China (n=165, 11.13%), the UK (n=150, 10.11%), Australia (n=132, 8.90%) and Canada (n=100, 6.74%), respectively. Pakistan (n=73, 4.92%), Spain (n=71, 4.79%), South Korea (n=60, 4.05%), and South Africa (n=59, 3.98%), as well as the Netherlands (n=51, 3.44%) and India (n=50, 3.37%) published almost the same number of studies. Türkiye stands out with 46 publications (3.10%) and Germany with 41 publications (2.76%). Türkiye and Germany are followed by Portugal (n=36, 2.43%), Malaysia (n=35, 2.36%), Taiwan (n=34, 2.29%), Norway (n=33, 2.23%), and France (n=31, 2.09%). Finally, among the top 25 countries, Saudi Arabia is represented by 29 (1.96%), New Zealand by 28 (1.89%), Brazil by 24 (1.62%), Italy by 23 (1.55%), Finland by 22 (1.48%), Israel by 22 (1.48%), and Belgium by 20 (1.35%) studies.

The distribution of 1,483 articles on authentic leadership according to the languages in which they were published between 1978 and 2022 is given in Figure 4.

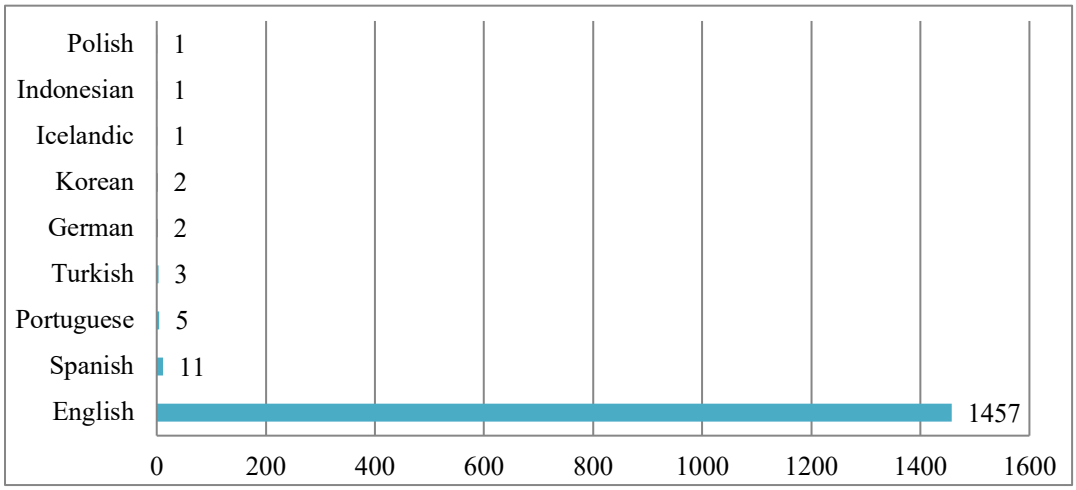

Figure 4. *Distribution of papers included in the research according to the languages in which they were published*

Table 4 indicates that English (n=1,457, 4.799%) dominated the publication language for authentic leadership research between 1978 and 2022. Other languages featured include Spanish with 11 articles (0.74%), Portuguese with 5 (0.34%), Turkish with 3 (0.20%), German and Korean with 2 each (0.13%), and Icelandic, Indonesian, and Polish with 1 article each (0.07%).

Findings on Bibliometric Analysis

In the context of the bibliometric analyses of the study, citation analysis (author, study, and journal), co-author analysis (author, institution, and country) and co-word (concept) analysis findings of the articles on authentic leadership published between 1978 and 2022 are given as subheadings.

Citation Analysis (Author, Study, Journal, and Institution)

Under the subheading of citation analysis, the distribution of the most influential (most cited) articles on authentic leadership between 1978 and 2022 according to author, study, journal, and institution were analysed. Accordingly, Table 2 shows the number of articles, citations, and link strengths of the top 20 most influential authors, with at least five articles on authentic leadership.

Table 2. Author/Researcher Ranking

Order. No	Author/researcher	Number of Papers	Number of Citations	Link Strength
1	William L. Gardner	16	3189	716
2	Bruce J. Avolio	10	2458	440
3	Fred Luthans	5	2168	289
4	Heather K. Spence Laschinger	20	1944	471
5	Fred O. Walumbwa	9	1923	399
6	Carol A. Wong	13	1643	463
7	Alexander Newman	7	842	132
8	Hannes Leroy	8	751	162
9	Armenio Rego	7	683	172
10	Miguel Pina e Cunha	7	625	168
11	Greta G. Cummings	5	602	146
12	Sean T. Hannah	6	428	106
13	Matej Cerne	9	345	108
14	Susanne Braun	7	343	182
15	Linjuan Rita Men	7	330	57
16	Kelly Davis McCauley	5	329	153
17	Emily Read	5	320	90
18	Niklas K. Steffens	7	315	125
19	S. Alexander Haslam	6	313	120
20	Claudia Peus	5	279	117

According to Table 2, the number of articles of the top 20 most influential authors with at least five articles on authentic leadership varies between 5 and 20, the number of citations between 279 and 3,189, and the link strength between 57 and 716. At the same time, as can be observed in Table 2, the top most influential authors/researchers with at least five papers on authentic leadership were established as William L. Gardner (Number of Articles =16, Number of Citations=3,189, Link Strength=716); Bruce J. Avolio (Number of Articles=10, Number of Citations=2,458, Link Strength=440); Fred Luthans (Number of Articles=5, Number of Citations=2,168, Link Strength=289); Heather K. Spence Laschinger (Number of Articles=20, Number of Citations=1,944, Link Strength=471); and Fred O. Walumbva (Number of Articles=9, Number of Citations=1,923, Link Strength=399).

Table 3 shows the ranking of the top 20 most cited articles on authentic leadership between 1978 and 2022.

Table 3. Ranking of Articles According to the Number of Citations

Order No	Article	Number of Citations
1	Walumbwa, F. O., Avolio, B. J., Gardner, W. L., Wernsing, T. S., & Peterson, S. J. (2008). Authentic leadership: Development and validation of a theory-based measure. *Journal of Management, 34*(1), 89-126. https://doi.org/10.1177/0149206307308913	1,242
2	Avolio, B. J., Gardner, W. L., Walumbwa, F. O., Luthans, F., & May, D. R. (2004). Unlocking the mask: A look at the process by which authentic leaders impact follower attitudes and behaviors. *The Leadership Quarterly, 15*(6), 801-823. https://doi.org/10.1016/j.leaqua.2004.09.003	957
3	van Dierendonck, D. (2011). Servant Leadership: A review and synthesis. *Journal of Management, 37*(4), 1228-1261. https://doi.org/10.1177/0149206310380462	779
4	Luthans, F., & Youssef, C. M. (2007). Emerging positive organizational behavior. *Journal of Management, 33*(3), 321-349. https://doi.org/10.1177/0149206307300814	677
5	Dinh, J. E., Lord, R. G., Gardner, W. L., Meuser, J. D., Liden, R. C., & Hu, J. (2014). Leadership theory and research in the new millennium: Current theoretical trends and changing perspectives. *The Leadership Quarterly, 25*(1), 36-62. https://doi.org/10.1016/j.leaqua.2013.11.005	590
6	Gardner, W. L., Cogliser, C. C., Davis, K. M., & Dickens, M. P. (2011). Authentic leadership: A review of the literature and research agenda. *The Leadership Quarterly, 22*(6), 1120-1145. https://doi.org/10.1016/j.leaqua.2011.09.007	522
7	Hoch, J. E., Bommer, W. H., Dulebohn, J. H., & Wu, D. (2018). Do ethical, authentic, and servant leadership explain variance above and beyond transformational leadership? A meta-analysis. *Journal of Management, 44*(2), 501-529. https://doi.org/10.1177/0149206316665461	448
8	Day, D., Fleenor, J., Atwater, L., Sturm, R., & Mckee, R. (2014). Advances in leader and leadership development: A review of 25 years of research and theory. *The Leadership Quarterly, 25*, 63-82. https://doi.org/10.1016/j.leaqua.2013.11.004	441
9	Avolio, B. J. (2007). Promoting more integrative strategies for leadership theory-building. *American Psychologist, 62*(1), 25-33. https://doi.org/10.1037/0003-066X.62.1.25	368
10	Brown, A. D. (2015). Identities and identity work in organizations. *International Journal of Management Reviews, 17*(1), 20-40. https://doi.org/10.1111/ijmr.12035	348
11	Owens, B. P., & Hekman, D. R. (2012). Modeling how to grow: An inductive examination of humble leader behaviors, contingencies, and outcomes. *Academy of Management Journal, 55*(4), 787-818. https://doi.org/10.5465/amj.2010.0441	342
12	Newman, A., Ucbasaran, D., Zhu, F., & Hirst, G. (2014). Psychological capital: A review and synthesis. *Journal of Organizational Behavior, 35*(Suppl 1), 120-138. https://doi.org/10.1002/job.1916	326
13	Kalshoven, K., Den Hartog, D. N., & De Hoogh, A. H. B. (2011). Ethical leadership at work questionnaire (ELW): Development and validation of a multidimensional measure. *The Leadership Quarterly, 22*(1), 51-69. https://doi.org/10.1016/j.leaqua.2010.12.007	326
14	Bailey, C., Madden, A., Alfes, K., & Fletcher, L. (2017). The meaning, antecedents and outcomes of employee engagement: A narrative synthesis. *International Journal of Management Reviews, 19*(1), 31-53. https://doi.org/10.1111/ijmr.12077	324
15	Hughes, D. J., Lee, A., Tian, A. W., Newman, A., & Legood, A. (2018). Leadership, creativity, and innovation: A critical review and practical recommendations. *The Leadership Quarterly, 29*(5), 549–569. https://doi.org/10.1016/j.leaqua.2018.03.001	306
16	Rego, A., Sousa, F., Marques, C., & Cunha, M. P. e. (2012). Authentic leadership promoting employees' psychological capital and creativity. *Journal of Business Research, 65*(3), 429-437. https://doi.org/10.1016/j.jbusres.2011.10.003	306
17	Banks, G. C., McCauley, K. D., Gardner, W. L., & Guler, C. E. (2016). A meta-analytic review of authentic and transformational leadership: A test for redundancy. *The Leadership Quarterly, 27*(4), 634-652. https://doi.org/10.1016/j.leaqua.2016.02.006	264
18	Bedi, A., Alpaslan, C. M., & Green, S. (2016). A meta-analytic review of ethical leadership outcomes and moderators. *Journal of Business Ethics, 139*(3), 517-536. https://doi.org/10.1007/s10551-015-2625-1	249
19	Avey, J. B., Wernsing, T. S., & Palanski, M. E. (2012). Exploring the process of ethical leadership: The mediating role of employee voice and psychological ownership. *Journal of Business Ethics, 107*(1), 21-34. https://doi.org/10.1007/s10551-012-1298-2	248
20	Baron, R. A., Franklin, R. J., & Hmieleski, K. M. (2016). Why entrepreneurs often experience low, not high, levels of stress: The joint effects of selection and psychological capital. *Journal of Management, 42*(3), 742-768. https://doi.org/10.1177/0149206313495411	246

As can be seen in Table 3, the number of citations received by the top 20 papers on authentic leadership ranged from 246 to 1,242. The authors of the top five most cited papers were Walumbwa et al. (2008) (number of citations=1,242), Avolio et al. (2004) (number of citations=957), van Dierendonck (2011) (number of citations=779), Luthans and Youssef (2007) (number of citations=677), and Dinh et al. (2014) (number of citations=590). However, it is understood that Walumbwa, Avolio, Gardner, and Luthans are at the forefront of the authentic leadership literature.

Table 4 shows the journal citation ranking of the top 20 articles on authentic leadership between 1978 and 2022. While creating Table 4, the journals that published at least five articles were considered criteria. Accordingly, we determined that 56 journals published at least five articles out of 524 journals that published articles on authentic leadership.

As can be observed in Table 4, the number of articles of the top 20 journals that received the most citations between 1978 and 2022 ranged between 5 and 71, the number of citations was between 262 and 7,450, and the link strength was in the range of 19 and 1,232. According to Table 4, the ranking for the most citations among the journals with publications on authentic leadership between 1978 and 2022 was Leadership Quarterly (number of papers=71, number of citations=7,450, link strength=1,232), Journal of Management (number of papers=9, number of citations=3834, link strength=669), Journal of Business Ethics (number of papers=53, number of citations=3,630, link strength=563), Journal of Nursing Management (number of papers=42, number citations=1,589, link strength=421), and Leadership & Organization Development Journal (number of papers=62, number of citations=1,091, link strength=477).

Table 5 shows the institution citation ranking of the top 20 articles on authentic leadership between 1978 and 2022. In Table 5, the institutions where at least five articles were published were taken into consideration. According to this criterion, we determined that 114 institutions published at least five articles out of 1,627 that produced publications on authentic leadership.

Table 5. Citation Ranking of Institutions

Order No	Name of Institution	Number of Papers	Number of Citations	Link Strength
1	University of Nebraska	12	4,166	1,204
2	Texas Tech University	19	3,336	1,332
3	University of Western Ontario	32	2,909	797
4	Arizona State University	13	2,446	767
5	Erasmus University Rotterdam	12	1,144	213
6	Durham University	12	1,080	297
7	Catholic University of Leuven	12	979	398
8	University of Exeter	9	933	181
9	University of Alberta	11	844	295
10	University of Illinois	9	764	117
11	Rochester Institute of Technology	5	747	184
12	Curtin University	8	728	116
13	University of Queensland	21	703	304
14	Washington University	9	701	183
15	University of Miami	17	686	329
16	Aveiro University	6	681	267
17	Colorado State University	6	666	83
18	University of North Carolina	14	654	274
19	Aston University	8	650	191
20	Tilburg University	8	603	111

As seen in Table 5, the number of articles on authentic leadership from the top 20 most cited institutions between 1978 and 2022 ranged between 5 and 32, the number of citations between 603 and 4,166, and the link strength between 83 and 1,332. According to Table 5, the institution that was most cited among those that published on authentic leadership between 1978 and 2022 was the University of Nebraska (number of articles=12, number of citations=4166, link strength=1,204). The University of Nebraska was followed by Texas Tech University (number of papers=19, citations=3,336, link strength=1,332), University of Western Ontario (number of papers=32, citations=2,446, link strength=797), Arizona State University (number of papers=13, citations=2,446, link strength=767), and Erasmus University Rotterdam (number of articles=12, citations=1,144, link strength=213). Table 6 shows that American universities have received more citations on authentic leadership than overall institutions.

Co-author Analysis (Author, Institution, and Country)

Under the subheading of co-author analysis, network analyses of the articles on authentic leadership between 1978 and 2022 based on collaboration by author, institution, and country were examined. Accordingly, Figure 5 shows the co-author network of 67 authors with at least five articles among 3,373 authors who published articles on authentic leadership.

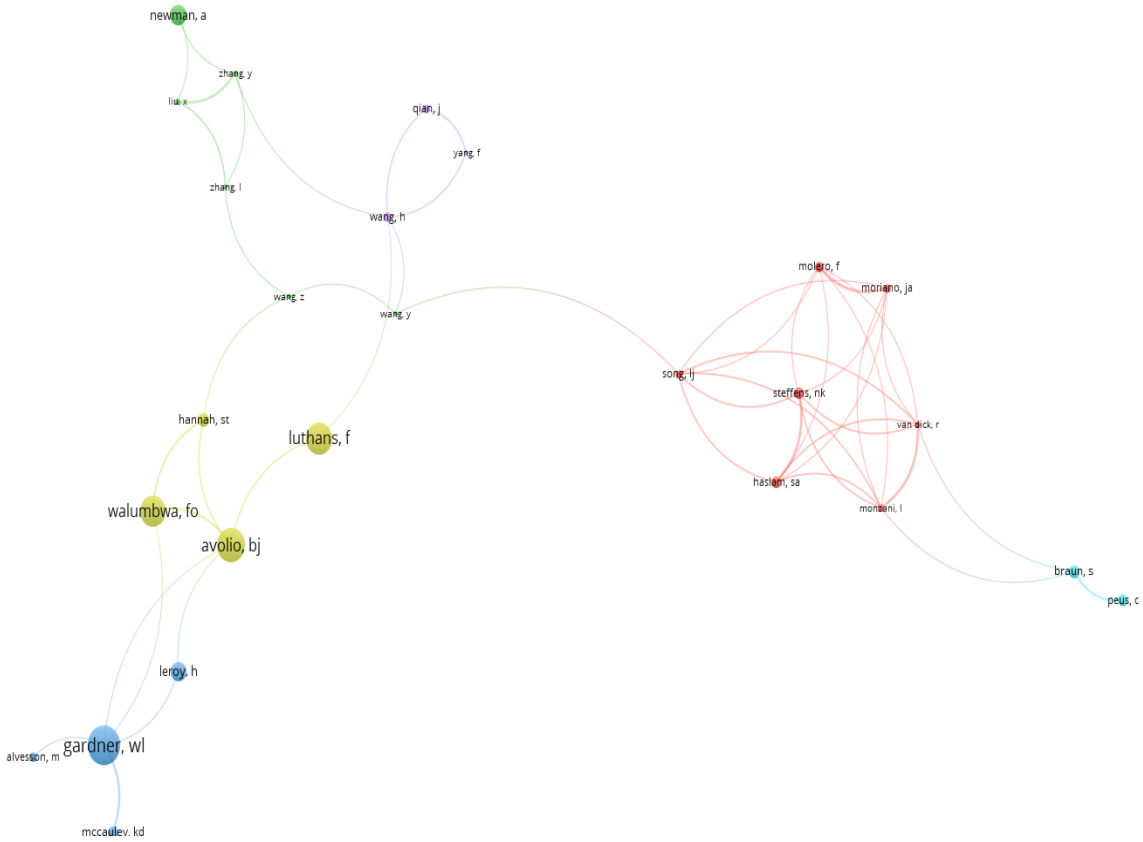

Figure 5. *Authorship network map within the scope of co-author analysis*

In Figure 5, circles (nodes) represent authors, node (circle) sizes represent published articles, and the thickness of the connecting lines and the distance between the nodes represent the degree of cooperation between authors. In this regard, when the inter-author collaboration network map is analysed, the authors with the highest link strength are Lucas Monzani (Link strength=15), Rolf van Dick (Link strength=15), S. Alexander Haslam (Link strength=14), Heather Laschinger (Link strength=14), and Niklas K. Steffens (Link strength=14), respectively. In addition, within the scope of the co-author analysis, six clusters were identified in the authorship network map, and each cluster was shown in six different colours: red, green, blue, yellow, purple, and turquoise. Within these clusters, the clusters with the same colour indicate the authors who are cited together, and the circles' size indicates the authors' importance in the cluster. The first cluster is represented in red and with seven authors (S. Alexander Haslam, Fernando Molero, Lucas Monzani, Juan Antonio Moriano, Lynda Jiwen Song, Niklas K. Steffens, and Rolf van Dick). The most significant authors of the red cluster are Niklas K. Steffens (Number of links=6, Link strength=14, Number of citations=315) and S. Alexander Haslam (Number of links=6, Link strength=14, Number of citations=313). The second cluster is green and includes six authors (Xin Liu, Alexander Newman, Yu Wang, Zhenyuan Wang, Lei Zhang, and Yucheng Zhang). The most significant author in the second cluster is Alexander Newman (Number of links=2, Link strength=2, Number of citations=842). There are four authors in the third cluster in blue (Mats Alvesson, William L. Gardner, Hannes Leroy, and Kelly Davis McCauley), and the most significant author of this cluster is William L. Gardner. (Number of links=5, Link strength=9, Number of citations=3,189). The fourth cluster in yellow consists of four authors (Bruce J. Avolio, Fred O. Walumbwa, Sean T. Hannah, and Fred Luthans) and its most significant author is Bruce J. Avolio (Number of links=5, Link strength=10, Number of citations=2,458). The fifth cluster is purple and comprises three authors (Jing Qian, Hui Wang, and Fan Yang). In the fifth cluster in purple, the most significant author is Hui Wang (Number of links=5, Link strength=7, Number of citations=200). Finally, the sixth cluster is turquoise and consists

of two authors (Susanne Braun and Claudia Peus). The most significant author of the sixth cluster is Susanne Braun (Number of links=3, Link strength=6, Number of citations=343).

Figure 6 shows the co-author citation network for 116 institutions, with at least five articles from 1,634 institutions with articles on authentic leadership between 1978 and 2022.

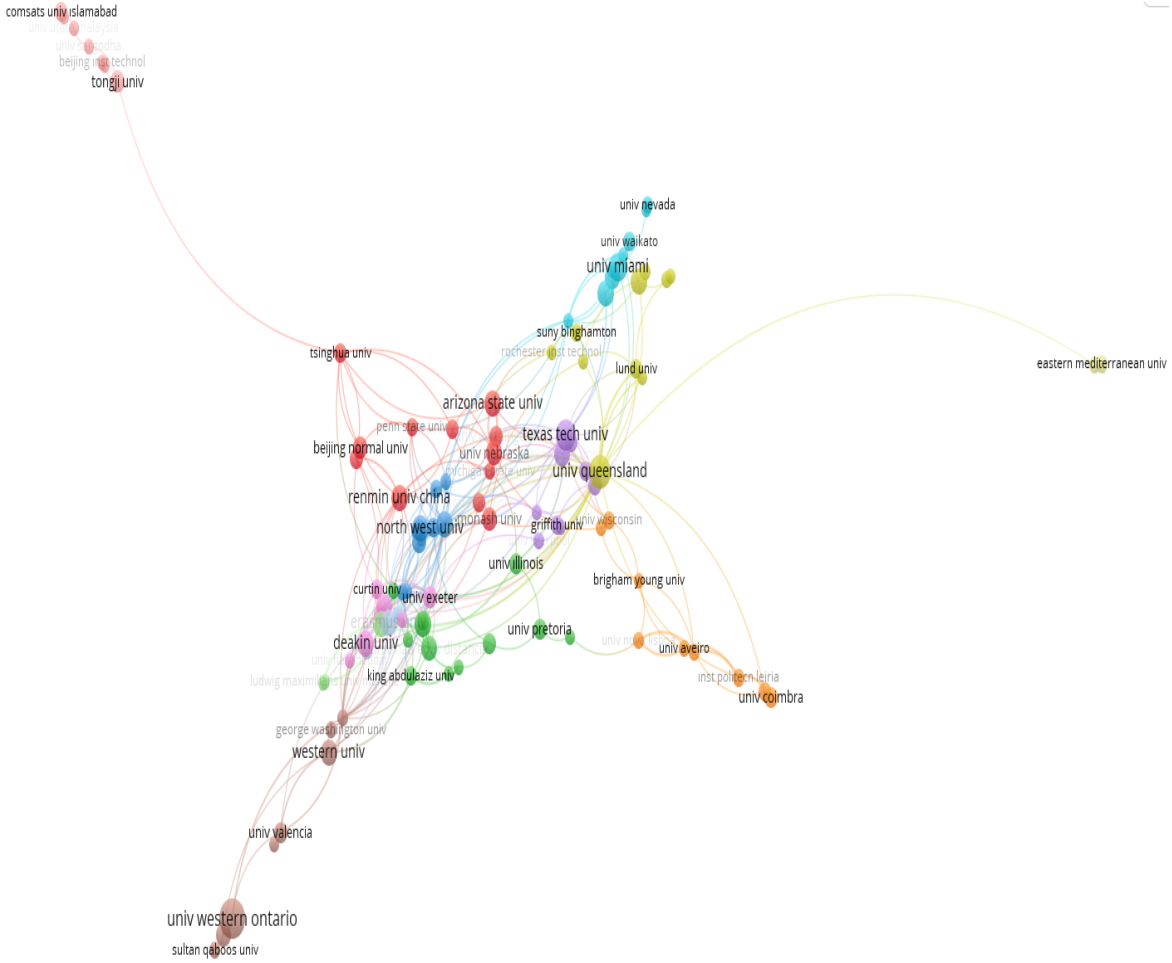

Figure 6. *Network map of inter-institutional cooperation within the scope of co-author analysis*

As can be observed, Figure 6 shows the distribution of citations on authentic leadership according to institutions (universities). The circles (nodes) in Figure 5 represent the institutions (universities), the node sizes show the published articles, and the thickness of the connecting lines and the distance between the nodes symbolise the degree of cooperation between the institutions. Accordingly, when the inter-institutional cooperation network map was examined, we found clusterings in 13 colours. However, within these clusters, the top 5 institutions (universities) that had the highest link strength were Catholic University of Leuven (Link strength=41), University of Queensland (Link strength=39), Durham University (Link strength=30), Erasmus University Rotterdam (Link strength=27), and Goethe University Frankfurt (Link strength=25), respectively. The universities in European countries have been found to cooperate in terms of authentic leadership.

Figure 7 shows the co-author citation network of 50 countries with at least five articles from 89 countries with publications on authentic leadership between 1978 and 2022.

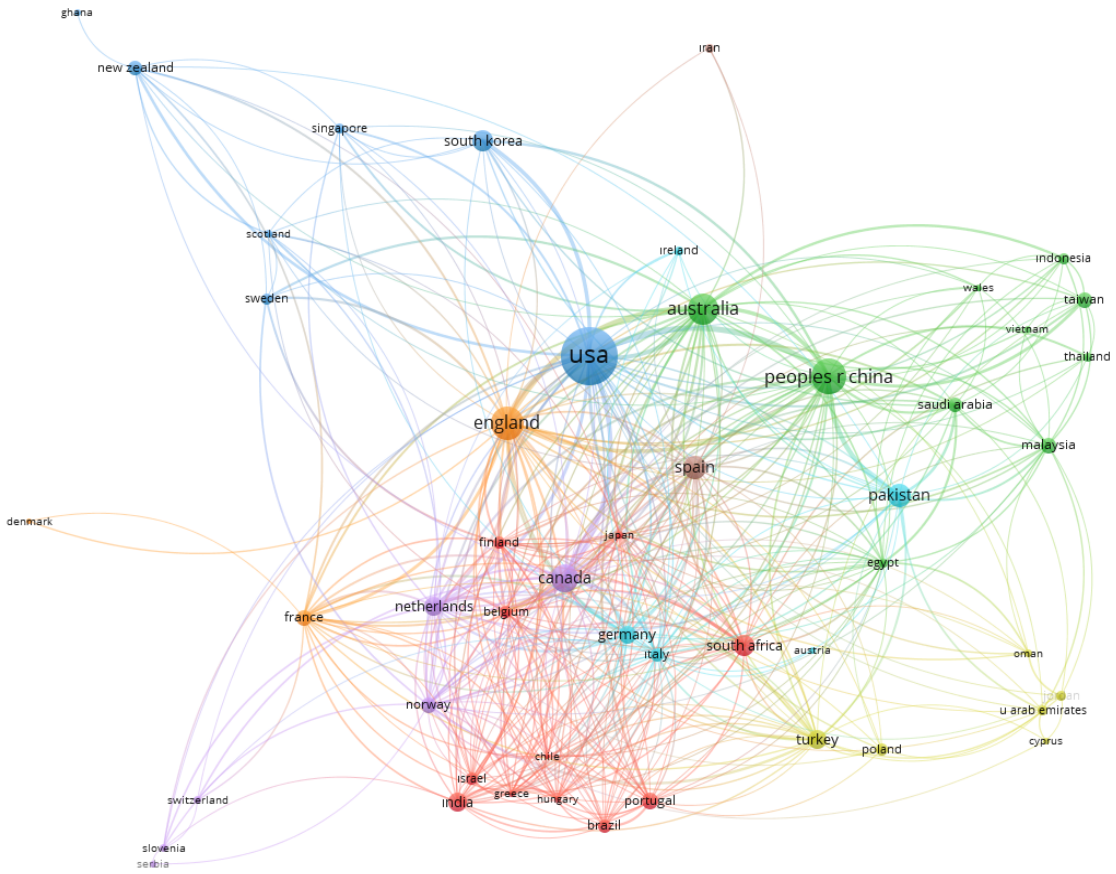

Figure 7. *Network map of inter-country cooperation within the scope of co-author analysis*

The circles (nodes) in Figure 7 represent the countries, the node sizes show the articles published, and the thickness of the connecting lines and the distance between the nodes symbolise the cooperation between countries. In the network map of inter-country cooperation, eight different coloured clusters have emerged. The country with the highest connection strength among these eight clusters is the USA (Link strength=180). The USA is followed by the UK (Link strength=178), the People's Republic of China (Link strength=156), Australia (Link strength=142), and Canada (Link strength=104). These results may imply cross-country cooperation on authentic leadership across different continents.

Co-concept (Word)

Network analyses of the concepts (words) commonly used in the articles on authentic leadership between 1978 and 2022 are examined under this heading. The analysis network map of 168 key concepts (words) that emerged according to the criterion of at least five repetitions of the total 3,233 key concepts (words) used about authentic leadership is given in Figure 8.

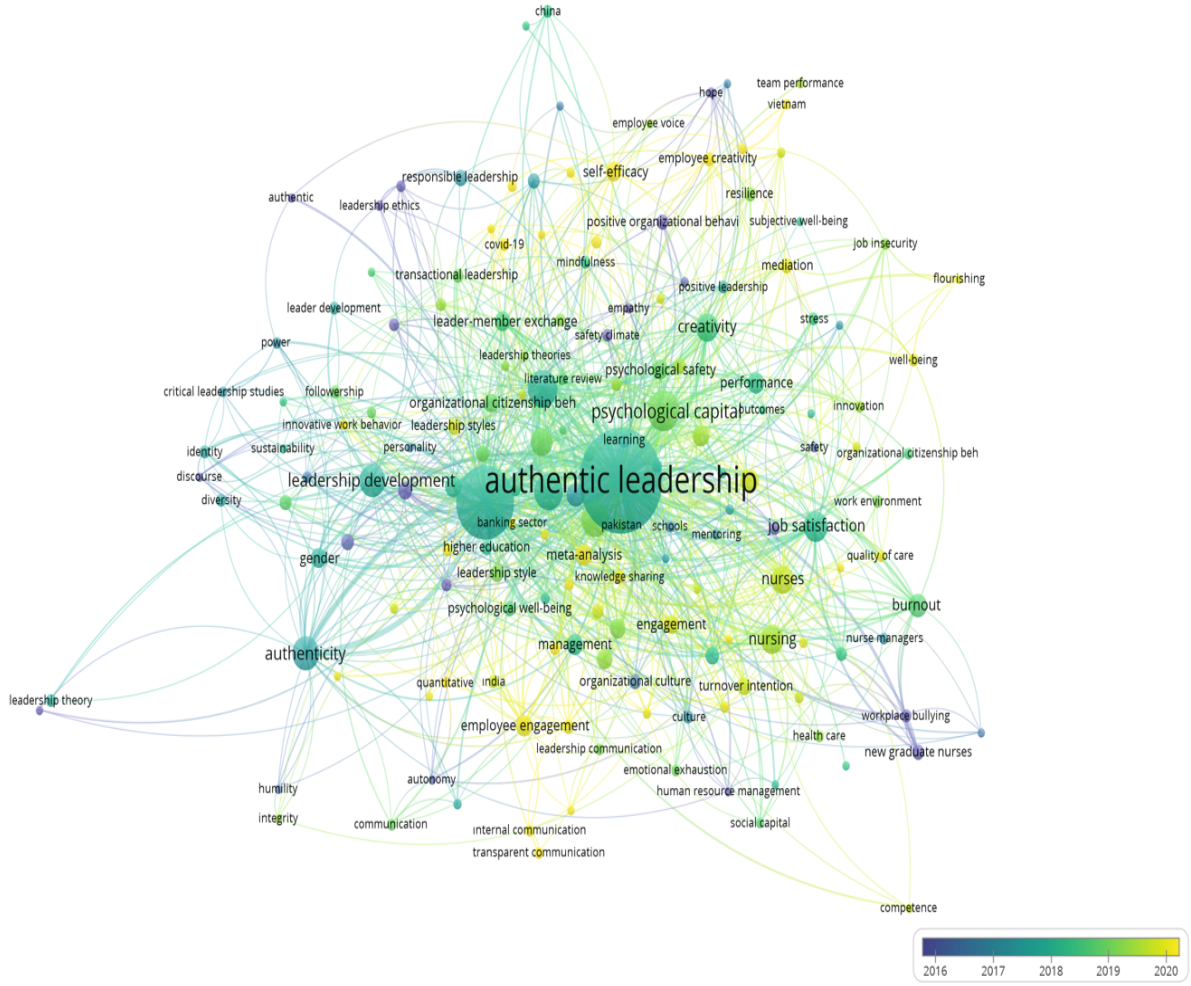

Figure 8. *Co-concept (word) network analysis of articles on authentic leadership*

As can be seen in Figure 8, we determined that the articles related to authentic leadership were grouped under 11 clusters within the scope of co-concept (word) network analysis. In the co-concept (word) network analysis, the size of the circles (nodes) represents the most frequently tackled concept (word), and the yellow areas symbolise the current concepts (words). The most repeated concepts (words) in the co-concept (word) network analysis are authentic leadership (*f*=524), leadership (*f*=259), psychological capital (*f*=79), ethical leadership (*f*=67), transformational leadership (*f*=63), job commitment (*f*=59), authenticity (*f*=55), leadership development (*f*=52), and job satisfaction (*f*=45), respectively. However, in recent years, we found that the up-to-date concepts (words) on authentic leadership were COVID-19, meta-analysis, subjective well-being, administration, information exchange, self-sufficiency, employee creativity, and organisational citizenship.

DISCUSSION & CONCLUSION

Articles on authentic leadership published in WoS indices between 1978 and 2022 were analysed in this study using descriptive and bibliometric analysis methods. The studies included in the research were tackled within the scope of descriptive analysis in terms of publication year, journal in which they were published, country, and language, and within the bibliometric analysis scope, the same studies were examined in terms of citation analysis (author, study, journal, and institution), co-author analysis (author, institution, and country), and co-concept (word) analysis. When all the results of the research are evaluated as a whole, it was revealed that the interest in authentic leadership has increased in recent years, and authentic leadership was used in conjunction with some current concepts such as COVID-19, meta-analysis, subjective well-being, administration, information exchange, self-sufficiency, employee creativity, and organisational citizenship.

According to the descriptive analysis, we found that the first study on authentic leadership was published in 1978. While the number of articles on authentic leadership was constant, and there was only one from 1978 to 2003, there was a continuous rise in the number of articles from 2004 to 2021. Ahmed (2023) states that the fact

that some academic journals (e.g. Educational Management Administration & Leadership / EMAL) published special issues on authentic leadership was influential in the continuous increase of authentic leadership studies between 2004 and 2021. In fact, EMAL published a special issue on authentic leadership in 2007, which increased academic interest in authentic leadership and enabled authentic leadership to be studied in different ways (Ahmed, 2023). However, it is noteworthy that the number of articles on authentic leadership in 2022 is lower than in 2021. Underlying this decline in the number of articles on authentic leadership may be the researchers gravitating towards current leadership styles or issues. For instance, the philosophy and content on which authentic leadership is based bear similar characteristics to a current leadership approach, such as ethical leadership. As a matter of fact, the fact that authentic leadership expresses a high and qualitative understanding of morality and consistency in actions and words (Avolio et al., 2004; Goffe & Jones, 2005; May et al., 2003; Wherry, 2012) and that it is considered as a leadership approach closely related to charismatic, transformative, and servant leadership approaches (Avolio & Gardner, 2005) support this inference.

Leadership Quarterly published the most articles on authentic leadership between 1978 and 2022. This journal is followed by Leadership Organisation Development Journal, Frontiers in Psychology, Journal of Business Ethics, Journal of Nursing Management, and Leadership. In other words, it can be said that the journals in which articles on authentic leadership are published tend to publish in fields that show diversity in areas such as leadership, organisation, management, health, and psychology. At the same time, the fact that the journals that publish the most articles on authentic leadership have good index and impact ratings indicates that the articles are qualitative studies. The fact that studies on authentic leadership are published in journals with different content may be due to the social and values-based leadership characteristics of authentic leadership because values-based leadership behaviours can be effective in solving social injustice, and economic and cultural problems. In other words, the fact that authentic leadership involves reliable, strong morality and transparent understanding contributes to solving social problems (Kılıç, 2019). Furthermore, the emphasis on ethics and morality by 21st-century leadership theorists has increased the tendency towards authentic leadership as values-based leadership (Bass & Steidlmeier, 1999; Gardner & Avolio, 2005; Brown & Trevino, 2006). This tendency may have led to the publication of studies on authentic leadership in various academic journals.

The USA takes the lead in the distribution of authentic leadership articles by country. We found that in addition to the USA, the People's Republic of China, the UK, Australia, and Canada have also published a significant number of articles on authentic leadership. In bibliometric analyses conducted on different disciplines in the literature, it has been reported that the USA leads in scientific publications (Ahmed, 2023; Gürken et al., 2019; Gümüş et al., 2018; Gümüş et al., 2020; Hallinger & Kovačević, 2019; Hallinger et al., 2020; Julia et al., 2020; Karagöz & Şeref, 2019; Özdemir et al., 2022; Samul, 2020; Türesin Tetik, 2022). This may be due to the incentives for scientific publication, academic freedom, and opportunities offered to researchers in the USA. According to Ahmed (2023), authentic leadership studies are most common in the USA because the USA has one of the largest higher education systems in the world. Similarly, Gümüş et al. (2018) attribute the fact that the studies on leadership are mostly from the USA to the fact that a significant part of leadership studies were initiated in the USA. On the African continent, it was observed that there were relatively fewer articles on authentic leadership compared to other continents. The countries' attitudes toward science and their level of development are presumed to influence the revelation of this result. One of the noteworthy results of the study is that countries such as Pakistan, Türkiye, Saudi Arabia, Taiwan, Malaysia, and New Zealand surpassed developed countries such as Belgium, Italy, Israel, and Finland in the number of articles on authentic leadership. Such a result can be explained by the fact that the countries' philosophies of life and opinions on life are similar to the general characteristics of the authentic leadership approach. This is because authentic leadership is a leadership approach related to knowing oneself, remaining natural, and preserving one's own authenticity (McShane & Glinov, 2016). Cultural values are also likely to play a role in the fact that countries such as Pakistan, Türkiye, Saudi Arabia, Taiwan, Malaysia and New Zealand have outpaced developed countries such as Belgium, Italy, Israel and Finland in terms of the number of publications on authentic leadership. In other words, it can be said that the society in which the leader lives or the cultural characteristics adopted by the leader are effective in authentic leadership. In fact, Barth and Tsemach (2021) found that self-awareness, transparency in relationships and balanced evaluation dimensions of authentic leadership were predicted by individualistic culture. In individualistic societies, individuals see themselves as independent and separate from others, whereas in collectivist societies, individuals see themselves as an essential part of society (Hofstede, 2001). Although there are exceptions, it is known that traditional culture represents collectivist culture, and industrial society represents individualist culture. The main characteristic that distinguishes collectivist culture from individualist culture is the commitment to tradition and authority in collectivist culture (Hofstede et al., 2010; Triandis & Gelfand, 1998). Therefore, it is assumed that

cultural characteristics and cultural context shape the authentic leadership behaviours of organisational leaders. In the present study, the fact that the number of publications on authentic leadership is higher in countries such as Pakistan, Türkiye, Saudi Arabia, Taiwan, Malaysia and New Zealand than in countries such as Belgium, Italy, Israel and Finland can be explained by cultural similarities.

Articles on authentic leadership between 1978 and 2022 were primarily published in English. In bibliometric studies conducted on different subjects in the literature, it was found that the number of publications in the English language was high as well (Çil Koçyiğit et al., 2023; Erturgut & Gürler, 2019; Yeşiltaş & Yılmazer, 2021). This outcome can be considered an expected result in studies. This is because academic circles recognise English as a universal scientific language worldwide. Therefore, accepting English as a universal language may have led to more articles being published in English than in other languages. On the other hand, although low in number, articles on authentic leadership were published in Spanish, Portuguese, Turkish, German, and Korean. This result may be related to the fact that Spanish, Portuguese, Turkish, German, and Korean journals are indexed in WoS.

Within the scope of citation analysis in the study, we found that the most cited author was William L. Gardner, the most cited article was Walumbwa et al.'s (2008) "Authentic leadership: Development and validation of a theory-based measure", the most cited journal was "Leadership Quarterly", and the most cited institution was "University of Nebraska". In other words, we can say that the most influential author on authentic leadership was William L. Gardner, the most influential article was Walumbwa et al.'s (2008) "Authentic leadership: Development and validation of a theory-based measure", the most influential journal was "Leadership Quarterly", and the most influential institution was "University of Nebraska". We believe that William L. Gardner, being one of the first authors to study authentic leadership and significantly contributing to the literature in shaping the theoretical infrastructure of authentic leadership, increased the number of citations. In terms of articles, the fact that Walumbwa et al.'s (2008) study titled "Authentic leadership: Development and validation of a theory-based measure" is geared towards the theoretical substructure of authentic leadership may have led this article to be cited more than others. In the bibliometric analysis of Margiadi and Wibowo (2020) on authentic leadership, they established that the most cited article was Avolio and Gardner's (2005) paper titled "Authentic Leadership Development: Getting to the Root of Positive Forms of Leadership". The diversity of the databases that Margiadi and Wibowo (2020) reviewed on authentic leadership may have led them to obtain different results from the results of the current study. The journal with the highest number of citations for articles on authentic leadership is "Leadership Quarterly", which can be explained by the fact that the said journal publishes the main theme of leadership. As a matter of fact, the bibliometric analysis study conducted by Samul (2020) and Baynal Doğan et al. (2021), as in this study, determined that the publications on leadership were primarily published in the journal "Leadership Quarterly". On the other hand, the fact that the most influential institution in terms of the number of citations is the University of Nebraska may be related to the fact that The University of Nebraska is a rooted and old university. Regarding the citation analysis results, the most determinative, the ones that guide the field the most, and the most influential in the field in terms of authorship, article, and institution are William L. Gardner's article titled "Authentic Leadership: Development and Validation of a Theory-based Measure", and the University of Nebraska, respectively. In this respect, we estimate that the results of the research on citation analysis will contribute to and provide a prediction for researchers who want to specialise in or study authentic leadership.

Under the subheading of co-author analysis in the study, network analyses of the articles on authentic leadership between 1978 and 2022 based on cooperation by author, institution, and country were examined. The highest link strengths were established as Lucas Monzani, Rolf van Dick, S. Alexander Haslam, Heather Laschinger, and Niklas K. Steffens in terms of co-authorship; Catholic University of Leuven, University of Queensland, Durham University, Erasmus University Rotterdam, and Goethe University Frankfurt in terms of institution; and the USA, People's Republic of China, Australia, and Canada in terms of country. These results generally point to cooperation between different authors, institutions, and countries on authentic leadership. However, various numbers of clusters were established in network analyses on this cooperation that emerged based on authors, institutions, and countries. There came about six clusters in the network analysis by authors, 13 clusters in the network analysis by institutions, and eight clusters in the network analysis by countries. The different number of clusters in the co-authorship analysis results may be evidence of the diversity of academic cooperation between authors, institutions, or countries. At the same time, postgraduate students or researchers who graduated from the universities they attended as students and returned to their home countries that published jointly and continued their cooperation with the universities they studied at and their professors from their postgraduate studies may also have ensured the said diversity in academic cooperation. In the analysis of co-authorship by country, the

fact that a country from almost every continent (the USA, the People's Republic of China, Australia, and Canada) has a high link strength except Africa may mean that there is cooperation between continents regarding authentic leadership. The absence of countries with high link strength in Africa can be explained by Africa's interest in and support for scientific studies from the academic development perspective.

As a result of the co-concept (word) analysis of the articles on authentic leadership, we observed that the concept with the highest frequency and the most central position was "authentic leadership". Similarly, Margiadi and Wibowo (2020) reported in their bibliometric analysis study on authentic leadership that the most repeated concept was "authentic leadership". The fact that "authentic leadership" is the most central and frequently repeated concept in authentic leadership papers may be related to the fact that authentic leadership is a primary and fundamental concept in these papers. The concept of authentic leadership is followed by the concepts of leadership, psychological capital, ethical leadership, transformational leadership, job commitment, authenticity, leadership development, and job satisfaction. This finding may indicate that authentic leadership is mostly analysed in conjunction with leadership, psychological capital, ethical leadership, transformational leadership, job commitment, authenticity, leadership development, and job satisfaction. However, in recent years, we have noticed that articles on authentic leadership often use current concepts such as "meta-analysis, subjective well-being, administration, knowledge sharing, self-sufficiency, employee creativity, and organisational citizenship" are frequently used. Therefore, it can be noted in the process that authentic leadership has been addressed in the literature along with changing dynamics and issues of interest. In a systematic review study, Ahmed (2023) found that authentic leadership is examined chiefly together with the variables of organisational citizenship, psychological empowerment, job commitment, structural empowerment, identification and psychological ownership. The same study reported that authentic leadership has a negative relationship with job stress, organisational deviance, resistance to change and turnover intention. Similarly, Avolio et al. (2004) emphasise that authentic leadership increases positive psychological behaviours. In other words, authentic leadership can influence employees' attitudes and behaviours through basic psychological processes such as identification, hope, positive emotions, optimism and trust (Alilyyania et al., 2018). Furthermore, many leadership studies in the literature clarify the relationship between authentic leadership and organisational variables (Adil & Kamal, 2020; Shapira-Lishchinsky & Ozery, 2018; Zhang et al., 2020). In the current study, it was found that authentic leadership studies were mainly examined together with similar topics such as organisational citizenship, job commitment and psychological capital. This finding may be related to the researchers' desire to draw attention to the effects of authentic leadership on positive organisational variables.

Limitations of the Study

In addition to the fact that this research put forth significant outcomes in terms of demonstrating the general tendency towards authentic leadership, we may also need to mention some of its limitations. The most significant limitations can be viewed as the fact that the research includes only the articles indexed in the WoS database, the exclusion of studies other than articles (such as book chapters, editorials, summaries of the minutes of meetings, conference booklets, etc.), and not including articles that are in the early view process or waiting to be published as of 2023 due to the fact that the research period was at the beginning of 2023. On the other hand, the fact that the values determined as threshold values in the analyses related to the research were established only based on the values provided by the VOSviewer software package and that the research results were not reported in accordance with thematic and content analysis may be interpreted as another limitation.

Suggestions

Despite all the limitations of the research, it can be suggested to researchers to include such publications in bibliometric analyses as those indexed outside of WoS databases like Google Scholar, EBSCO Host, Scopus, and ERIC, and non-article studies such as book chapters, editorials, summaries of meetings, and conference booklets all include the year 2023. On the other hand, comparisons on authentic leadership can be made by using different visual mapping programmes such as Pajek, Ucinet, Citespace, and Rstudio. Finally, as in this bibliometric analysis, it should be kept in mind that the analysis results may also change if the pre-determined threshold values change and that the research may be repeated with thematic and content analyses.

Statements of Publication Ethics

Since this is a bibliometric study, it does not require approval from the ethics committee.

Conflict of Interest

There is no conflict of interest in this research. The research was carried out without any commercial or financial support from any legal person, institution or organisation.

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The Predictor of Attitudes Towards Brain Drain Among Nursing Students in Türkiye: Violence in Healthcare

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Abstract

It is known that the rates of brain drain among qualified healthcare professionals in our country are increasing. Additionally, it has been reported that violence against healthcare workers has rapidly risen in recent years, and this increase has affected the attitudes of professionals towards brain drain. Therefore, examining the relationship between nursing students' attitudes toward brain drain and their perceptions of safety against violence in healthcare is considered a valuable research topic. The aim of our study is to investigate the relationship between nursing students' attitudes toward brain drain and their perceptions of security and safety against violence in healthcare. To examine the relationship between the two scales, our descriptive study employs a correlational research design. The study population consists of nursing students with Turkish citizenship studying in Türkiye. Based on the known population sampling calculation, the study was planned to include at least 382 students. Data were collected from 400 nursing students through a Google survey between February and June 2023. The Student Information Form, the Nursing Students' Attitudes Toward Brain Drain Scale, and the Safety and Security Scale for Healthcare Workers Against Violence were utilized in the data collection process. According to the findings, 68.8% of the students expressed dissatisfaction with the healthcare policies implemented in our country, while 90.8% reported concerns about their professional lives due to violence against healthcare personnel. Additionally, it was determined that the students' attitudes toward migration were largely influenced by external factors, and those dissatisfied with healthcare policies had higher levels of these attitudes. It was found that the average scores of students who were dissatisfied with healthcare policies and worried about the violence applied were lower. Moreover, no significant relationship was identified between students' attitudes toward brain drain and their perceptions of safety. In light of these results, it is recommended that the factors influencing nursing students' attitudes toward brain drain be investigated further, and studies addressing these factors be planned.

Keywords: Brain drain, perception of trust, perception of safety, nursing, student, violence in healthcare.

Türkiye'de Hemşirelik Öğrencilerinin Beyin Göçüne Yönelik Tutumlarının Yordayıcısı: Sağlıkta Şiddet

Öz

Ülkemizde nitelikli sağlık profesyonelleri arasında beyin göçü oranlarının arttığı bilinmektedir. Aynı zamanda, ülkemizde sağlık çalışanlarına uygulanan şiddetin son yıllarda hızla arttığı ve bu artışın çalışanların beyin göçüne yönelik tutumlarını etkilediği de bildirilmektedir. Dolayısıyla geleceğin sağlık alanında nitelikli iş gücü içerisinde önemli bir konumda olacak hemşirelik öğrencilerinin, beyin göçüne yönelik tutumlarının ve sağlıkta şiddete karşı güven algıları ile ilişkisinin incelenmesinin değerli olacağı düşünülmüştür. Bu doğrultuda araştırmamızın amacı, hemşirelik öğrencilerinin beyin göçüne yönelik tutumları ile sağlıkta şiddete karşı güvenlik ve güven algıları arasındaki ilişkinin incelenmesidir. İki ölçek arasındaki ilişkiyi incelemek üzere korelasyonel araştırma desenine sahip tanımlayıcı tipteki araştırmamızın evrenini Türkiye'de eğitim gören TC uyruklu hemşirelik öğrencileri oluşturmuştur. Evren bilinen örneklem örneklem hesabına göre en az 382 öğrenci ile araştırmanın yapılması planlanmıştır. Araştırmamızda veriler, Şubat-Haziran 2023 tarihlerinde google anket aracılığıyla 400 hemşirelik öğrencisi ile toplanmıştır. Verilerin toplanmasında, Öğrenci Bilgi Formu, Hemşirelik Öğrencilerinin Beyin Göçüne Yönelik Tutum Ölçeği ve Sağlık Çalışanlarının Şiddete Karşı Güvenlik ve Güven Ölçeği kullanılmıştır. Öğrencilerin %68,8'i ülkemizde uygulanan sağlık politikalarından memnun olmadığını, %90,8'i sağlık personeline uygulanan şiddet nedeniyle meslek yaşamlarına dair endişe duyduklarını bildirmiştir. Öğrencilerin göç etmeye yönelik tutumlarının çoğunlukla dış faktörlerden etkilendiği ve sağlık politikalarından memnun olmayanların tutumlarının daha yüksek olduğu belirlenmiştir. Sağlık politikalarından memnun olmayan ve uygulanan şiddetten kaygı duyan öğrencilerin ise sağlıkta şiddete karşı güvenlik ve güven algıları puan ortalamalarının daha düşük olduğu tespit edilmiştir. Öğrencilerin beyin göçüne yönelik tutumları ile güven algıları arasında anlamlı bir ilişki saptanmamıştır. Bu sonuçlar doğrultusunda, hemşirelik öğrencilerinin beyin göçüne yönelik tutumlarını etkileyen faktörlerin araştırılması ve bu faktörlere yönelik çalışmaların planlanması önerilmektedir.

Anahtar kelimeler: Beyin göçü, güven algısı, güvenlik algısı, hemşirelik, öğrenci, sağlıkta şiddet.

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INTRODUCTION

Brain drain refers simply to the international transfer of labor. Typically, the migration of educated and skilled individuals occurs from developing countries to developed countries (Thapa & Shrestra, 2017). Individuals with higher education and expertise in their fields prefer to settle in countries where they can work under better conditions and enjoy a higher standard of living. Today, developed countries allocate a significant portion of their resources to attract highly educated and skilled individuals into their educational sectors. Consequently, international brain drain movements have gained substantial momentum in recent years (Yılmaz, 2019).

Considering the existing research findings, the factors contributing to brain drain can be viewed as push factors, including disparities in earnings between countries, adverse living conditions in the destination countries, economic challenges, security and political reasons, wars, extremely limited job opportunities, and deficiencies in health policies (Kirigia et al., 2006; Nguyen et al., 2008; Thapa & Shrestra, 2017). The pull factors include high quality of life in developed countries, demand for skilled labor, and opportunities for education and employment (Kirigia et al., 2006; Nguyen et al., 2008; Thapa & Shrestra, 2017).

When examining recent data, there appears to be a growing trend toward brain drain among nurses. Nurses make up the majority of qualified health professionals within the healthcare system, and the demand for skilled labor is increasing every day (Bimal & Kaur, 2016). While only 5% of nurses were reported to be working in rural areas in the 1970s, a 2014 report from the Organisation for Economic Co-operation and Development noted a 60% increase in migration rates among doctors and nurses (ILO, 2014). The migration of highly educated healthcare workers adds to the workload of other healthcare staff. This situation restricts access to quality healthcare for other segments of society, leading to inequalities within the healthcare system (Sell & Williams, 2020; WHO Health Reports, 2006). A study reported that 11% of nurses working in the United States are foreign nationals, with 80% of them migrating from developing countries (Thapa & Shrestha, 2017). In Ghana, 24% of nurses work abroad (Abuosi & Abor, 2015). The international literature indicates that countries experiencing brain drain often do so due to the adverse effects of health policies on healthcare workers (Bimal & Kaur, 2016). Although studies examining nurses' attitudes toward brain drain in Türkiye are limited, existing research suggests that nurses generally hold a favorable attitude toward it (Gökbayrak, 2008; Mollahaliloğlu et al., 2014). Thus, the potential increase in brain drain rates in the coming years has become an issue warranting consideration. Investigating the factors that specifically influence attitudes toward brain drain is of significant importance.

Some studies report that incidents of violence in healthcare impact healthcare workers' attitudes toward brain drain (Khan et al., 2021; Şahin & Yıldırım, 2020). One study indicated that the primary reason for healthcare students and professionals considering brain drain is the rising occurrence of violence in healthcare services (Ünlü & Daşlı, 2024). A study found that from 2017 to 2021, incidents of violence in healthcare increased 5.2 times compared to previous years, with the highest number of cases occurring in the Marmara region, particularly in state hospitals and internal medicine departments (Hoşgör & Türkmen, 2021). Violence in healthcare institutions is one of the primary components negatively affecting employee safety and causing disruptions in healthcare delivery. This situation adversely impacts patient health, employee safety, and leads healthcare personnel to feel unsafe in their work environment (Khan et al., 2021; Şahin & Yıldırım, 2020). Employees develop perceptions of safety based on their life experiences and, similarly, have expectations of safety when experiencing violent situations. If these expectations are positively fulfilled, the threshold of trust increases, leading to the development of a perception of safety (Moloney, 2005; Yılmaz, 2019). Employee safety is one of the fundamental principles required for individuals to sustain their working lives. Studies conducted in our country indicate that the safety perceptions of healthcare workers are generally at low to medium levels (Şengül et al., 2019; Özmen & Koyuncu, 2022; Yural et al., 2024). The lack of a perception of safety among healthcare workers in their institutions increases their tendency to leave these institutions and even to seek employment in other countries. With the increasing migration rates and the potential for further increases, the definition and assessment of migration have become critically important in healthcare workforce planning (Solak, 2014; Şenay, 2008; WHO Health Reports, 2006). Therefore, it is essential to examine migration trends among nurses, who constitute a vital part of the healthcare system. According to the research findings of Hoşgör and Türkmen, the higher incidence of violence in certain geographic regions and institutions suggests that healthcare workers' tendency toward brain drain may vary depending on the regions in which they work (Hoşgör & Türkmen, 2021). Therefore, it is evident that the impact of demographic differences on attitudes toward brain drain also needs to be investigated. Furthermore, investigating the attitudes of nursing students-who will become the future healthcare workforce-toward migration

and the factors that may influence this is crucial for making more appropriate investments in skilled labor and healthcare education.

Studies emphasize that violence against healthcare workers has rapidly increased in recent years in our country, particularly in certain regions and institutions (Özmen & Koyuncu, 2022; Şengül et al., 2019; Ünlü & Daşlı, 2024; Yural et al., 2024). Consequently, it is believed that studies examining the relationship between nursing students' attitudes toward brain drain and their perceptions of safety against violence in healthcare will be valuable, given that they will hold significant positions in the future skilled healthcare workforce.

Therefore, our research aims to investigate the relationship between the attitudes of nursing students studying in Türkiye toward brain drain and their perceptions of safety and security against violence in healthcare. To this end, we seek to answer the following research questions:

- What are the attitudes of student nurses towards brain drain?
- What are student nurses' perceptions of safety and trust against violence in healthcare?
- Is there a significant relationship between student nurses' attitudes towards brain drain and their perception of trust against violence in healthcare?
- Do student nurses' attitudes towards brain drain differ according to socio-demographic characteristics?
- Do student nurses' perceptions of trust against violence in healthcare differ according to socio-demographic characteristics?

METHOD

Research Design and Sample

Descriptive correlational research is a type of research design that seeks to explain the relationship between two or more variables without making any claims about cause-and-effect relationships (Büyüköztürk et al., 2018). Therefore, our study was planned as a descriptive correlational research to investigate the relationship between nursing students' attitudes towards brain drain and their perceptions of trust and safety against violence in healthcare. The population of this study consists of all students enrolled in undergraduate nursing programs. The accessible population, however, includes students studying in undergraduate nursing programs in Türkiye. According to the 2022 updated data from the Council of Higher Education, the accessible population comprises 55,417 students who are enrolled in undergraduate nursing programs and hold Turkish citizenship (https://istatistik.yok.gov.tr/). According to the calculation of the known sample size of the population, the number of samples is 382 (95% confidence interval, it was determined as (with a margin of error of .05) (Büyüköztürk et al., 2018). Due to the online nature of our research, the criteria for including participants were determined as follows: they must have no issues with reading and writing skills, must voluntarily participate in the study in accordance with ethical principles, and it was considered that international students' desire to work abroad could be influenced by various factors, as they might not be sufficiently aware of the health conditions in our country. Therefore, only students who are citizens of the Republic of Türkiye were included in our research. In this regard, our research was completed with 400 students.

Data Collection Tools

Research data were collected using the "Student Information Form," the "Attitude Scale Towards Brain Drain in Nursing Students," and the "Health Professionals' Safety and Confidence Against Violence Scale." Prior to their use, permission to utilize the scales was obtained from the authors who conducted the validity and reliability assessments in Turkish.

Student Information Form

This is the form that includes questions about the students' age, the region where the university they study at, the name of the university they study at, their class, and the economic situation of their family.

Attitude Scale Towards Brain Drain in Nursing Students

The scale developed by Öncü et al. in 2018 aims at students' attitudes towards brain drain and consists of a total of 16 items. The scale items are of 5-point Likert type and the lowest score is 16 points and the highest score is 80 points. An increase in the score obtained from the scale indicates that the individual's attitudes towards migration have increased. The scale has two sub-dimensions: 'pull factors' and 'push factors'. The total Cronbach alpha value of the scale is 0.91, and the values for the sub-dimensions are 0.88 and 0.86.15 In our research, the total Cronbach alpha coefficient of the scale was determined as 0.91.

Health Professionals' Safety and Trust Against Violence Scale

The health professionals' safety and trust against violence scale was developed by Kowalenko et al. in 2012. The validity and reliability of the Turkish form of the scale was checked by Şengül et al. in 2019. The sub-dimension and overall score of the safety and trust against violence scale are calculated by taking the arithmetic average of the items. A minimum of 1 point and a maximum of 10 points are taken from the general and sub-dimensions of the scale. An increase in the score obtained from the scale indicates that security, trust and management of violence against violence have increased. The scale has the first sub-dimension, which is security and violence management, and items 2 and 3 in the security sub-dimension are reverse scored. The total Cronbach alpha value of the scale, which has seven items, is 0.84 (Şengül et al., 2019). In our research, the total Cronbach alpha value of the scale was found to be 0.76.

Collection of Data

Data were collected between February and June 2023 through a Google survey prepared with Microsoft Forms. The statements in the survey were designed to be simple and understandable for the students. To test the comprehensibility of the survey, a pilot test was conducted with five students. After confirming that there were no issues with the clarity or technical aspects of the survey, it was administered. At the beginning of the survey, participants were asked to confirm their voluntary participation. Additionally, to prevent the same students from filling out the survey multiple times, it was set up so that each email address could only submit the survey once. However, adjustments were made in the settings to ensure that participants' identities remained anonymous despite the requirement to log in with their email addresses. It was estimated that each student would spend approximately 10-15 minutes completing the survey.

Evaluation of Data

Data were analyzed in IBM SPSS 24.0 program. In the analysis of descriptive data, frequency (n), percentage (%), mean, standard deviation (SD), skewness (multiply) and kurtosis (bas) values were used. It was observed that the skewness and kurtosis values were within the range of ±1.5. According to this finding, it was determined that the measurement scores were suitable for univariate normal distribution. For the measurement scores of the variables suitable for normal distribution, independent samples t-test was used for comparison tests of two independent groups, One-way ANOVA test, Bonferroni Test was used for comparison tests of more than two independent groups, and Pearson correlation test was applied to examine the direction and strength of the relationships between two numerical measurements. To evaluate the statistical analysis findings, the margin of error was taken as 5% and $p<0.05$ values were considered statistically significant.

Research Ethics

Before starting the research, approval was obtained from the Social and Humanities Ethics Committee of a university (2022-SBB-0618, 02.02.2023) and permission for use was received via e-mail from the authors who carried out the validity and reliability of the scale. Before administering the survey, students were informed that the data would be used for scientific purposes within the scope of the research and that their information would be kept confidential, and they were asked to give consent during the survey that they participated voluntarily.

FINDINGS

Analysis of Data Related to Nursing Students

Descriptive information about nursing students is included in Table 1. The average age of the participants was 20.95±1.93 and the majority (31.5%) were first-year students. Students mostly participated from the Black Sea Region (46.5%) and least from the Central Anatolia Region (6.8%). 68.8% of the students reported that they were not satisfied with the health policies implemented in our country, and 90.8% reported that they were worried about their future professional lives due to the violence against healthcare personnel.

Table 1. Descriptive Information about Nursing Students

Variables		n	%
Geographical region where he/she studied	Eastern anatolia	40	10.0
	Southeastern anatolia	31	7.8
	The mediterranean	30	7.5
	Aegean	45	11.3
	Marmara	41	10.3
	Black sea	186	46.5
	Central anatolia	27	6.8
The class he/she studied	1st grade	126	31.5
	2nd grade	86	21.5
	3rd grade	88	22.0
	4th grade	100	25.0
Satisfaction with health policies	Yes	125	31.3
	No	275	68.8
Concern about their professional lives due to violence against healthcare personnel	Yes	363	90.8
	No	37	9.3
Age	Min: 17.00 Max:35.00 Mean±SD: 20.95±1.93		

* %: Percent; Min: Minimum; Max: Maximum; SD: Standard Deviation

Examination of the Average Scale Scores of Nursing Students

Table 2 shows the results of the scale total and subscale total scores that students were asked to fill in. Health Professionals' Security and Trust Against Violence Scale Safety Sub-Dimension mean score is 14.97±5.11, Trust Sub-dimension mean score is 13.47±3.36, and the scale total score mean is 37.71±8.88. Attitude Scale Towards Brain Drain in Nursing Students Attitude Scale Pull Factors sub-dimension mean score is 25.23±9.10, Nursing Students Attitude Scale Towards Brain Drain Push Factors sub-dimension mean score is 25.23±9.10, and the scale total score mean is 57.11. It is ±13.10.

Table 2. Nursing Students' Attitude Scale Towards Brain Drain and Health Professionals' Safety and Confidence Against Violence Scale Total and Sub-Dimension Mean Scores

Variables	Dimensions	Mean±SD	Min-Max	Q25-Q75
Attitude Scale Towards Brain Drain in Nursing Students	Attractive Factors	25.23±9.10	12-51	18-35
	Push Factors	13.80±3.21	4-20	12-16
	Total score	57.11±13.10	16-80	50-66
Health Professionals' Safety and Confidence Scale Against Violence	Security Sub-Dimension	14.97±5.11	3-29	11.25-18
	Trust Sub-Dimension	13.47±3.36	4-20	12-16
	Total score	37.71±8.88	7-65	33-43

* Min: Minimum; Max: Maximum; SD: Standard Deviation; Q25-Q75: First and Third Quartiles

Investigation of the Relationship Between the Average Scale Scores of Nursing Students

Table 3 shows the relationship between the Attitude Scale Towards Brain Drain in Nursing Students and some data variables of the students. Accordingly, a highly significant relationship was detected between students' satisfaction with health policies and their attitudes towards brain drain ($p<0.001$). It was determined that the attitudes of students (59.17±12.31) who were dissatisfied with health policies towards brain drain were more positive. However, no significant relationship was found between other variables of the students and their attitudes towards brain drain ($p>0.05$).

Table 3. The Relationship Between the Attitude Scale Towards Brain Drain in Nursing Students and Some Variables

Variables		Mean±SD	Statistics value	p[a]	%95 min-max
Satisfaction with health policies	Yes	50.61±13.80	t=-6.199	0.000	-11.27- -5.84
	No	59.17±12.31			
Violence against healthcare personnel concerns their professional life	Yes	56.56±13.11	t=0.303	0.762	-3.84- 5.24
	No	55.86±16.00			

a: independent test

Investigation of the Relationship Between the Average Scale Scores of Nursing Students and Their Demographic Data

Table 4 shows the relationship between the Health Professionals' Safety and Confidence Against Violence Scale and some data variables of the students. Accordingly, a significant relationship was detected between the

students' satisfaction with health policies, whether violence against healthcare personnel made them worry about their professional lives, the geographical region in which they were educated, and the Health Professionals' Security and Trust Against Violence Scale score average ($p<0.05$). Students who are not satisfied with health policies (35.08±9.17), who say that violence against healthcare personnel worries their professional life (37.12±8.36) and who study in the Mediterranean Region (30.96±9.30) have lower perceptions of safety and trust against violence in healthcare. was detected ($p<0.05$). According to the results of the Bonferroni test, which was conducted to determine the group that created the difference according to the region in which the students studied, a significant difference was detected between the students studying in the Mediterranean Region and all other regions ($p>0.05$).

Table 4. The Relationship Between the Health Professionals' Safety and Confidence Against Violence Scale and Some Variables

Variables		Mean±SD	Statistical value	p	%95 Min-max	Statistical value[c]
Satisfaction with health policies	Yes	38.83±8.70	t=4.302	0.000[a]	2.19-5.87	
	No	35.08±9.17				
Violence against healthcare personnel concerns their professional life	Yes	37.12±8.36	t=-4.23	0.000[a]	-9.31- -3.40	
	No	43.48±11.50				
Geographical region where he/she studied	Black Sea (1)	38.37±8.75	F=3.871	0.001[b]	37.10-39.63	6<1-2-3-4-5-7 <0.05
	Mediterranean (2)	30.96±9.30			27.49-34.44	
	Eastern Anatolia (3)	38.12±9.25			35.16-41.08	
	Central Anatolia (4)	36.77±7.83			33.67-39.87	
	Aegean (5)	38.57±10.79			35.33-41.82	
	Marmara (6)	39.90±5.90			38.03-41.76	
	Southeastern Anatolia (7)	36.45±7.21			33.80-39.09	

a: independent test; b: ANOVA test; c: Bonferroni test

Comparison of Scale Mean Scores

According to the results of the correlation analysis between the average age of the students and the scale score averages and between the two scale score averages, no statistically significant relationship was detected. Analysis results are shown in Table 5.

Table 5. Correlation Analysis Results of Nursing Students' Attitude Scale Towards Brain Drain and Health Professionals' Safety and Confidence Against Violence Scale

Variables	Attitude Scale Towards Brain Drain in Nursing Students (Mean+SD: 56.50+13.38)	Health Professionals' Safety and Confidence Scale Against Violence (Mean+SD: 37.71+8.88)
Age (Mean+SD: 20.95+1.93)	r= 0.002 p= 0.964	r= 0.026 p= 0.598
Health Professionals' Safety and Confidence Scale Against Violence (Mean+SD: 37.71+8.88)	r= -0.081 p= 0.1105	-

DISCUSSION & CONCLUSION

According to our research findings, the average score on the Attitude Scale Toward Brain Drain is 57.11±13.10, indicating that students' attitudes are above average (the lowest possible score is 16, and the highest is 80). In a previous study, the average score for nursing students' attitudes toward brain drain was reported as 42.98±9.91. Another study found that the average score for fourth-year nursing students was 51.15±11.31, which is similar to our findings (Demiray et al., 2020; Turan, 2021). Research indicating a high tendency for migration among nursing students suggests that the issue of nurse migration may become a growing concern in the future (Demiray et al., 2020; Turan, 2021).

Our research results indicate that the average score on the Health Professionals' Safety and Confidence Against Violence Scale is at a medium level, with a score of 37.71±8.88 (the lowest possible is 7, and the highest is 70). Students who expressed dissatisfaction with health policies and indicated that violence against healthcare personnel raised concerns about their professional lives had statistically significantly lower scale scores ($p<0.05$). Filiz et al. (2022) observed a high number of medical students who believed that the healthcare system in Türkiye

was severely inadequate and that societal perceptions of physicians were negative. Tansel and Güngör (2004) reported that students who went abroad for education cited economic and political instability as reasons for their migration. These data align with our findings, indicating that violence against healthcare personnel, professional concerns, and health policies are common reasons driving students abroad. Additionally, it is believed that students' perceptions of safety against violence are not at the desired level and that health policies, along with news of violence against healthcare personnel, negatively affect their sense of security.

According to Yılmaz (2019), the factors driving brain drain from Türkiye to other countries include economic reasons, the inadequacy of scientific and academic conditions, and the superior scientific and technological conditions in the destination countries. Attractive factors leading healthcare professionals to migrate include higher income, better working conditions, political stability, career opportunities, and a brighter future, whereas push factors include low wages, adverse working conditions, limited career opportunities, political difficulties, violence, and persecution. Consequently, these factors also influence attitudes and perceptions toward brain drain. In our study, the subscale score averages revealed that students' tendencies to migrate are primarily influenced by external factors (pull factors sub-dimension=25.23±9.10; push factors sub-dimension=13.80±3.21). Furthermore, it was reported that 68.8% of the students participating in our research expressed dissatisfaction with the health policies of our country, and 90.8% reported concerns about their future professional lives due to violence against healthcare personnel. Additionally, those dissatisfied with health policies exhibited statistically significantly higher tendencies toward brain drain. According to these findings, dissatisfaction with health policies is one of the factors influencing students' attitudes toward migration. Health policies can be a significant determinant in shaping perceptions of safety against violence in healthcare. Therefore, dissatisfaction with health policies is considered a factor that affects perceptions of safety against violence and attitudes toward migration. However, the absence of probing questions regarding pull factors constitutes a limitation of our research. Nonetheless, it is evident that the attitudes of the students participating in the study are influenced by both internal and external factors.

In our study, the average scale scores of students studying in the Mediterranean Region were statistically significantly lower ($p<0.05$). The significantly lower perception of security among students in this region suggests that they may have witnessed more incidents of violence. However, it should be noted that making definitive comments on this issue is challenging. Although comparisons have been made in the literature regarding students' attitudes and predictors of brain drain based on their grade levels and regions, the lack of existing research that allows comparisons based on the specific areas of study complicates the interpretation of these reasons. There is a clear need for further research in this area.

Our research did not find any statistically significant relationships between the average ages of students and other variables or their scale score averages. Additionally, correlation analyses between the mean scores of the two scales revealed no statistically significant relationships. It appears that students' attitudes toward brain drain are predominantly influenced by attractive, or external, factors, but also by internal factors, as students unmistakably express dissatisfaction with health policies (90.8%). This percentage is indeed noteworthy. Moreover, the desire to migrate was statistically significantly higher among those dissatisfied with health policies (50.61±13.80 vs. 59.17±12.31, $p<0.001$). Simultaneously, students who expressed dissatisfaction with health policies and indicated that news of violence concerned their professional lives had statistically significantly lower perceptions of security. It is evident that students' dissatisfaction with health policies affects the average scores of both scales, reduces their perception of security, and increases their desire to migrate. However, the absence of a direct relationship between brain drain and perception of security was an unexpected result. Many studies have reported that violence in healthcare increases the migration desire among various student groups and healthcare workers (Demiray et al., 2020; Tansel & Güngör, 2004; Yıldırım & Dündar, 2017; Yücel, 2022). These studies also indicate that the presence of violence in healthcare negatively affects nurses' motivation and job satisfaction. Constant exposure to violence can elevate nurses' professional stress levels and lead to psychological exhaustion. Consequently, nurses often seek to protect themselves from such violent incidents by relocating to countries that offer safer working environments. Therefore, further studies examining the tendencies toward violence and migration while considering different predictors can be planned. Investigating the migration trends and related factors of undergraduate nursing students-who are particularly close to entering the nursing profession-will be beneficial in developing more appropriate educational strategies and health policies.

The migration of professional nurses who have graduated from our undergraduate programs may lead to a decline in the quality of healthcare services. Our research findings indicate that nursing students exhibit a strong desire to migrate, and those dissatisfied with health policies experience diminished perceptions of security.

Simultaneously, incidents of violence in healthcare raise concerns about their professional futures. These results are indeed thought-provoking. They suggest that health policymakers need to develop new strategies concerning future healthcare workforce planning. Additionally, further studies are required to understand the predictors of nursing students' migration desires to contribute to these strategies. Therefore, our recommendation to researchers is to plan by considering the internal and external factors that may influence students' migration desires and to analyze the relationships among these factors comprehensively. The underlying causes should be examined thoroughly. Initiatives should be taken to improve nurses' working conditions, enhance their living standards, and expand their career opportunities. In this context, planning corrective actions such as regulating working hours, improving conditions for long working hours, increasing the emphasis on in-service training to meet international care standards, encouraging participation in programs such as conferences, courses, and seminars to support career development, and providing a safer working environment will be a significant investment in building healthy societies for the future.

Limitations

Our strengths include including students from different regions and institutions to cover all of Türkiye in our research, determining the sample size using the sample population known as the universe based on the total number of nursing students according to Higher Education Institution data, and reaching the determined sample number. However, in our research, a comparison was made on a single scale (Health Professionals' Safety and Confidence Against Violence Scale), which will push students to brain drain, and the data we collected included questions that point to more push factors. These constitute the limitations of our research. Therefore, detailed consideration of all the factors that push brain drain and planning of research will eliminate these limitations. In addition, developing comprehensive scales that examine the factors influencing the reasons for brain drain and attitudes towards it will be beneficial in preventing imbalanced brain drain movements.

Statements of Publication Ethics

In our study, the publication process was followed in accordance with ethical principles.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
SA	☐	☒	☐	☒	☒	☒
YÖ	☒	☒	☒	☒	☒	☒
EY	☒	☒	☒	☐	☒	☒
İM	☒	☐	☒	☐	☒	☒
MK	☒	☐	☒	☐	☒	☒

Conflict of Interest

There are no conflicts of interest in this study.

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