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A Gifted High School Student's Abstraction Process of Divisibility Rules

Üstün Yetenekli Bir Lise Öğrencisinin Bölünebilme Kurallarını Soyutlama Süreci

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Abstract

Purpose: Gifted students are often motivated by complex mathematical tasks. Mathematical abstraction allows access to gifted students' cognitive processes in knowledge construction. The question "How and why do the divisibility rules work?" evokes in them an intellectual need for constructing the working principle of a divisibility rule. Hence, this research focused on a gifted high school student's abstraction process of divisibility rules. By examining mathematical abstraction through observable actions, this study presents a deeper insight into the gifted student's thoughts, difficulties, and strategies regarding the working principle of divisibility rules.

Design/Methodology/Approach: The data was obtained from a 9th-grade gifted high school student through clinical interviews in a case study research design. The data were analyzed using the RBC+C abstraction theoretical framework's epistemic actions: *Recognizing, Building-with, Constructing*, and *Consolidating*.

Findings: The gifted student could recognize and use the necessary prior knowledge about divisibility to abstract the divisibility rules. In the construction process, the student explored the complex divisibility rules based on the place values of numbers with different digits.

Highlights: The student needed guidance in the process of creating more complex divisibility rules. With the researcher's help, the student could understand even more complicated divisibility rules and consolidate the cognitive way.

Öz

Çalışmanın amacı: Üstün yetenekli öğrenciler genellikle karmaşık matematiksel görevlerle motive olurlar. Matematiksel soyutlama, üstün yetenekli öğrencilerin bilgi alanındaki bilişsel süreçlerine erişim sağlar. "Bölünebilme kuralları nasıl ve neden çalışır?" sorusu, onlarda bir bölünebilirlik kuralının çalışma prensibini inşa etmek için entelektüel bir ihtiyaç uyandırır. Bu nedenle, bu araştırma üstün yetenekli bir lise öğrencisinin bölünebilme kurallarını soyutlama sürecine odaklanmıştır. Matematiksel soyutlamayı gözlemlenebilir eylemler aracılığıyla inceleyen bu çalışma, üstün yetenekli öğrencinin bölünebilme kurallarının çalışma prensibine ilişkin düşünceleri, zorlukları ve stratejileri hakkında daha derin bir bakış sunmaktadır.

Materyal ve Yöntem: Veriler, nitel araştırma deseninde dokuzuncu sınıf üstün yetenekli bir öğrenciden klinik görüşme yöntemiyle elde edilmiştir. Veriler, RBC+C soyutlama teorik çerçevesinin *Tanıma-Recognizing, Kullanma-Building with, Oluşturma-Constructing ve Pekiştirme-Consolidation* epistemik eylemleri kullanılarak analiz edilmiştir.

Bulgular: Üstün yetenekli öğrencinin bölünebilme kurallarını soyutlamak için bölünebilme ile ilgili gerekli ön bilgileri tanıyabilmiş ve kullanabilmiştir. Öğrenci, oluşturma sürecinde farklı basamaklı sayıların basamak değerlerinden yola çıkarak daha karmaşık bölünebilme kurallarını keşfetmiştir.

Önemli Vurgular: Öğrenci, daha karmaşık bölünebilme kurallarının soyutlanma sürecinde araştırmacı rehberliğine ihtiyaç duymuştur. Araştırmacının rehberliği ile öğrenci, bilişsel olarak daha karmaşık bölünebilme kurallarının altında yatan mantığı anlayabilmiştir.

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INTRODUCTION

Gifted students have the potential for showing, an exceptional level of performance in one or more areas of expression" (National Association for Gifted Children, 2005, p. 4). Especially high potential in mathematics is generally considered to be an understanding of mathematical ideas beyond arithmetic calculations (Miller, 1990). In this regard, gifted students in mathematics use their superior abilities by making associations and trying to understand the world (Sheffield, 1994). For this reason, most countries recognize and appreciate the unique characteristics of gifted students, and they have given significant attention to addressing and meeting their specific educational requirements (Mofield, 2020; VanTassel-Baska et al., 2021). However, gifted students follow the same curriculum at the same speed as other students in regular mathematics classes, without any changes to meet their individual needs (Diezmann & Watters, 2001; Dimitriadis, 2011). The standardized education primarily comprises memorization and similar messy activities, which fail to stimulate gifted students (Johnson, 2000; Maggio & Sayler, 2013).

The relevant literature shows that gifted students are often motivated by abstract and challenging contexts and materials (Perrone et al., 2010; Siegle et al., 2014). Such challenging tasks help them abstract mathematical knowledge by spending time and effort to find, apply and evaluate appropriate mathematical tools (Brousseau, 1997; Girit-Yıldız & Durmaz, 2021; VanTassel-Baska & Brown, 2007). Mathematical abstraction requires establishing relationships between concepts, understanding the source of information and knowing the areas of use. Since mathematical abstraction could be examined by observable actions, it is possible to reach gifted students' cognitive processes in knowledge construction processes (e.g., İnan, 2019). In other words, examining gifted students' knowledge construction processes with observable actions provides deeper information about what they think, where they have difficulties, and what strategies and concepts they use (Hershkowitz et al., 2001). However, like in many other countries, the educational system in Turkey fails to adequately support the needs of gifted students (e.g., Kanlı & Özyaprak, 2016). Leikin (2011) emphasizes the gap between mathematics education and gifted education studies. Therefore, there is a need for well-organized studies that will focus on gifted students' mathematical abstraction processes to meet their needs at primary and secondary education levels.

In the current study, we focused on the abstraction process of a ninth-grade student who was diagnosed as gifted during the problem solving process related to divisibility rules due to several reasons. Divisibility is a necessary and important concept for understanding the conceptual structure of number theory (Fitrianti & Suryadi, 2020; Shekatkar et al., 2015; Zazkis, 2008). The concept of divisibility is at the basis of many mathematical concepts, like arithmetic, the division algorithm, the greatest common divisor, polynomials, and the Euclidean algorithm from primary education to the end of undergraduate education (Potgieter & Blignaut, 2018). In recent years, the tendency to focus on real-life situations in mathematics education has revealed the danger of seeing divisibility rules as a result of division, an abstract and useless technique for memorization, or a trick (Zazkis, 1999; Zazkis et al., 2013). However, rather than memorizing divisibility rules, it is necessary to engage in mathematical reasoning by developing and testing conjectured rules or trying to understand how and why the rules work (Nahir, 2008; Zazkis et al., 2013). The question "How and why do the divisibility rules work?" evokes in learners an intellectual need for constructing and proving the working principle of a divisibility rule. One of the main goals of research in mathematics education is to better understand how students construct abstract mathematical knowledge (Dreyfus & Kidron, 2014). In such activities, learners create a new structure that gives a different perspective on previous knowledge (Tsamir & Dreyfus, 2002). Hence, they become aware of the mathematical structures and organize them to create a new structure to perform a mathematical task in the mathematical abstraction process. For this reason, the abstraction process of divisibility rules can provide opportunities to reveal gifted students' mathematical thinking through the analysis of observable epistemic actions. Therefore, this process can offer challenges and opportunities that align with the potential of gifted students. In this context, the current study seeks to address the following question: "What is a gifted high school student's process of abstraction regarding the divisibility rules?"

Significance of the study

In this study, we introduced the case of Alp (a pseudonym). He was a gifted ninth grader shown a willingness to openly and clearly communicate his ideas, thoughts, and uncertainties. He specifically inquired about the operational principles behind various divisibility rules. Alp, an exceptionally talented and self-reflective student, offered the researcher tremendous chances to closely study his cognitive processes while he participated in recognizing and constructing pre-established knowledge structures. Alp's desire to engage in open and honest communication with the interviewer, not only by giving accurate answers but also by voicing his doubts and views when he was unclear, provides valuable insights into the student's goals of knowledge and understanding. Dreyfus et al. (2015) also asserted that abstraction takes place when small groups of two to four students engage in classes. Nevertheless, even in a scenario with only two students, it is still conceivable for one student to take charge. Additionally, there may be situations where it is not feasible to distinguish between the epistemic actions of the students or gather sufficient knowledge about one of them. For this reason, this research was conducted with a single student to acquire comprehensive data on the process of abstraction.

In our context, examining the gifted students' abstraction processes can guide teachers in terms of developing high-level thoughts and meeting gifted students' needs by offering examples of a challenging context related to divisibility rules. Hence, teachers can possess a deep understanding of the cognitive processes occurring in the minds of their students, particularly in relation to how they grasp abstract mathematical concepts. This knowledge is crucial for creating effective learning environments that allow gifted students to express their unique mathematical ideas during lessons (Dreyfus et al., 2015) since addressing gifted

students' needs within the regular education setting is a vital challenge for experts and proponents of gifted education (Johnsen, 2021). The findings of the current study may guide researchers and teachers who want to benefit from differentiated educational opportunities parallel to gifted students' cognitive needs in their classroom environments (Baykoç et al., 2014; Özdemir & Işıksal-Bostan, 2021). From a curricular standpoint, while there is currently no explicitly defined mathematics curriculum for use with Science and Art Centers (SACs), there is a significant desire to develop one in Turkey. The current study demonstrates how a gifted student in Turkey was able to construct knowledge of divisibility rules at different complexity levels. We expect the findings to be beneficial for task designers and curriculum creators working on SACs.

THEORETICAL BACKGROUND

Mathematical Abstraction Process

There is no common definition in the literature on the concept of abstraction. However, abstraction is expressed in its simplest form as raising from concrete to abstract or as a process that directs the concept to the product (e.g., Ozmantar & Monaghan, 2007). In the process of abstraction, which has a complex structure, the student becomes aware of the mathematical structures and organizes them to create a new structure to perform a mathematical task. The abstraction process cannot be observed directly because it contains details about cognitive processes (Dreyfus et al., 2001; Dreyfus, 2007; Hershkowitz et al., 2001). In this sense, researchers have defined observable epistemic actions, which include visualization of mental actions through students' verbal expressions or physical actions, in the RBC abstraction theory (Dreyfus 2007, Hershkowitz et al., 2001). These epistemic actions are R*ecognizing*, *Building-with, and Constructing*. *Recognizing* means the realization of a mathematical structure that is already familiar to the student as a result of earlier abstractions. If students do not recognize the structure, they cannot move on to the other stages. The second epistemic action, *building-with* involves using known pieces of mathematical elements with new content to solve a problem or achieve a goal. Since the process is in the form of combining old information with new information, the act of building-with also includes the recognition process. *Constructing* consists of combining and integrating previous structures with a *vertical reorganization to* produce a new structure. Vertical reorganization typically refers to a process in which previous mathematical structures within mathematics are rearranged and students construct a new abstract structure (Dreyfus et al., 2015). The creation of a structure can usually occur when the individual thinks intensely on this mathematical subject alone (Dreyfus et al., 2001). According to the theory, the act of constructing is not independent of recognizing and building-with, and includes both actions. The key difference between building-with and constructing is that the act of building-with involves using existing constructs to solve a problem or explain a situation, while the act of constructing involves establishing a mathematical generalization. The fragility of newly acquired structures in the abstraction process makes it difficult for this knowledge to become permanent (Monaghan & Ozmantar, 2006). Therefore, the need for *consolidation* has emerged as an essential and integral part of the abstraction for the permanence of abstracted information (Monaghan & Ozmantar, 2006). In this direction, the RBC model was updated as RBC+C by adding consolidation as a cognitive action.

Abstraction is handled from two perspectives, *cognitive* and *sociocultural.* Cognitive abstraction claims that learning abstraction will take place based on the similarities in the examples presented on the subject. According to the view that considers abstraction from a sociocultural perspective, there is an understanding that learning cannot occur independently of the environment, social interactions, and conditions (Hershkowitz et al., 2001). In this sense, Hershkowitz et al. (2001) proposed abstraction in context that evaluates the abstraction process in forming knowledge from a sociocultural perspective. Abstraction in context has a student-centered understanding that requires student-student, teacher-student, student-tool interactions due to its sociocultural nature. In gifted education, it is not enough for the student to be born as gifted, s/he needs support from the teacher or the program. In this sense, the teacher has a crucial role in supporting gifted students' distinct needs (Brigandi et al., 2019; Özdemir & Isiksal-Bostan, 2021). In the present study, we decided to use the RBC+C model from the sociocultural perspective as an analytical framework to examine a gifted student's abstraction process on divisibility rules, since we took into account the student-teacher interactions (Hershkowitz et al., 2001; Ozmantar & Monaghan, 2007). Furthermore, due to the challenge of distinguishing between the epistemic actions of two students in an intervention (Altun & Yılmaz, 2010; Dreyfus et al., 2015; Kobak-Demir & Gür, 2019; Tsamir & Dreyfus, 2002), we focused on a gifted student's knowledge-construction processes.

National and international studies examining students' abstraction of mathematical knowledge based on the RBC or RBC+C model have focused on various mathematical concepts such as probability and statistics (Dreyfus et al., 2015; Katrancı & Altun; 2013); full and piecewise functions (Altun & Yılmaz, 2010); quadrilaterals (Butuner & İpek, 2023); coordinate systems and line equations (İlgün et al., 2018); linear relationships (Altun & Durmaz, 2013); limits (Sezgin-Memnun et al., 2017); infinite sets (Dreyfus & Tsamir, 2004; Tsamir & Dreyfus, 2002), fractions (Özçakır-Sümen, 2019) and parabola (Kobak-Demir & Gür, 2019) at various grade levels. However, the number of studies that aim at gifted students' abstraction processes on any mathematical concept is quite low (e.g., Çıldır, 2014; İlgün et al., 2018). For example, Çıldır (2014) examined how students abstracted the concept of the equation with two gifted secondary school students. In another study, İlgün et al. (2018) gave various problem situations to a gifted high school student and discussed the process in which the student formed the line equation passing through the origin. The results of both studies showed that gifted students could perform observable cognitive epistemic actions using the RBC+C model. In the study, the gifted students could recognize and use the knowledge they had previously formed, and they formed and consolidated the targeted mathematical knowledge about the concept correctly at a certain level. We could not find any study

that focuses on high school students' abstraction of the divisibility rules, although many concepts such as least/greatest common divisors, factorization, and polynomials in high school require knowledge of divisibility rules. Memorization of the divisibility rules can cause the information not to be fully structured in the mind (Zazkis & Campbell, 1996). As a result, students can stay at the level of remembering the information rather than recognizing and using the information. Therefore, examining gifted students' abstraction process of the divisibility rules will contribute to developing an understanding of their difficulties and needs in order to plan effective teaching approaches.

Literature on divisibility rules

The concept of divisibility has relations with division, multiplication, composing and decomposing of numbers, factorization, prime numbers, and divisibility rules (Zazkis & Campbell, 1996). Divisibility can be defined as follows: If $a, b \in Z, b \neq 0$, we say a divides b and write $a|b$ means that $b = a \cdot k$ for some $k \in Z$. This implies that b can be expressed as a multiple of a. In this sense, there is a strong relationship between divisibility and multiplicative structure of natural numbers. In early grades, students learn that a is a factor of b if a can divide into b without any remainder (The Ministry of Turkish National Education [MoTNE], 2018a). Divisibility rules can be employed to ascertain the primality of a number by examining if the number possesses any factors other than one and itself. By utilizing the divisibility rules, students can ascertain whether both the numerator and denominator of a fraction are divisible by the same integer, thus establishing if the fraction can be simplified. Students who possess knowledge of the divisibility laws will also possess the ability to employ a sound approach to determine the lowest common multiple or greatest common denominator of two or more non-zero numbers. In the curricula, it is recommended that students are motivated to memorize and apply the divisibility rules to enhance their mental calculating abilities (MoTNE, 2018a).

Early mathematics knowledge, especially about divisibility, is an important predictor of later mathematics achievement (Claessens & Engel, 2013; Siegler et al., 2012). However, many students see divisibility rules as abstract and useless (Zazkis, 1999), although some of them are useful in our daily lives (Chakraborty, 2007; Zazkis, 1999). For instance, the divisibility rules for 7 and beyond 10 are rarely discussed in middle or high school curricula although those rules provide opportunities to explore magical relationships between numbers (Eisenberg 2000; Zazkis 1999). In particular, divisibility by 7, 11, and 13 can be remembered as completely strange and unnecessary (Zazkis, 1999), although these rules reveal how mathematics is driven not only by usefulness but also by the desire to find patterns, beauty, and elegance (Eisenberg 2000; Zazkis 1999; Zazkis, Sinclair & Liljedahl, 2013). However, although many students and prospective teachers mostly remember some popular divisibility rules like divisibility by 2, 3, 4, 5, 9, and 10, they have difficulties proving them (Zazkis, 1999) or they often make the mistake of applying these rules too broadly or incorrectly (Zazkis & Campbell, 1996). Matz (1982) argued that these errors can be explained as students' unsuccessful attempts to adapt previously learned knowledge to a new situation. For this reason, it is necessary to engage in mathematical reasoning through developing and testing conjectured rules or trying to understand how and why the rules work (Zazkis, Sinclair & Liljedahl, 2013), since one of the main goals of research in mathematics education is to better understand how students construct abstract mathematical knowledge (Dreyfus & Kidron, 2014). For example, the divisibility by 3 states that a number is divisible by 3 if the sum of its digits is divisible by 3. However, the main point to be questioned should be why it should be so, rather than the sum of its digits must be a multiple of three for a number to be divisible by 3.

Gofer (1986) found that even fourth and fifth grade gifted students could discover different aspects of divisibility that they had not known previously when they were encouraged to reason and relate ideas. They were keen to think in an abstract way and in depth. In a recent study, Dinamit and Ulusan (2023) examined the proving processes of five 11th-grade Turkish science high school students who were diagnosed with giftedness from the Science and Art Education Centre. They found that gifted students could not complete the proof of divisibility by 3. They only memorized the divisibility rules, but they expressed a desire to acquire knowledge regarding the proof of the divisibility rule in the interview process. In the abstraction processes, Coşar and Keşan (2021) found that the gifted student utilized a cognitive rehearsal strategy to consider her prior structure of divisibility rules and associated it with the problem situation. These studies indicate the importance of abstraction process in understanding details of gifted students' mathematical knowledge related to divisibility rules. In this sense, our study can broaden the results of these studies since we focused on a gifted student's mathematical abstraction processes regarding divisibility rules at different complexity levels. We think that the results of this study are important for the design and shaping of teaching tasks related to divisibility rules for both gifted and non-gifted students in terms of designing effective discourse in a classroom environment. Moreover, we could not find any study that focuses on high school students' abstraction of the divisibility rules, although many concepts such as least/greatest common divisors, factorization, and polynomials in high school require knowledge of divisibility rules. Memorization of the divisibility rules can cause the information not to be fully structured in the mind. As a result, students can stay at the level of remembering the information rather than recognizing and using the information. Therefore, examining the students' abstraction process of the divisibility rules will contribute to developing an understanding of the difficulties and needs of students in this process and to planning effective teaching approaches.

METHODS

In this study, we used a qualitative research approach to obtain detailed and rich information about the student's actions in the problem solving process related to divisibility. In particular, we utilized a singular-case approach (Yin, 2014) to analyze a gifted high school student's construction of mathematical understanding of divisibility rules.

The Case

This research focused on a gifted male student named Alp, who was in the ninth grade in a public science high school in Turkey. Science high schools are secondary educational institutions (grades 9–12) that admit students based on high performance in a central examination. They employ a more extensive specialized mathematics curriculum than other secondary education institutions, equipping students for careers in the natural sciences and mathematics. The weekly hours allocated to science and mathematics courses markedly increase, especially after the 10th grade (Güçyeter et al., 2017). Nonetheless, their identification method is inadequate as it exclusively depends on a statewide multiple-choice examination that basically evaluates intellectual achievement.

Alp was the sole student in his class identified as gifted in mathematics. In Turkey, the Ministry of National Education (MoTNE) identifies gifted students through the Science and Art Centers (SACs). SACs facilitate the education and advancement of gifted students in Grades 2–12 by providing supplementary instruction in science, mathematics, foreign languages, literature, music, visual arts, social studies, and computing after school. A three-phase evaluation process is utilized to select gifted students for SACs. Initially, educators recommend their kids by filling out an online form. In the following phase, a committee performs a collective evaluation of the nominees. The committee evaluates students who meet or exceed the designated criteria, analyzing their performance in the chosen talent domain (intellectual ability, art, and music) indicated in their application. Intellectual capacity is assessed using findings from standardized tests, such as the Wechsler Intelligence Scale for Children–Revised Form (WISC-R), together with evaluations by specialists, to identify talented individuals. Students scoring 130 or above on these IQ exams qualify for attendance at a SAC. Due of Alp's proficiency in mathematics, he enrolled in additional mathematics courses at the SAC after school. Furthermore, the mathematics teacher, who was both a researcher and performed the interviews in this study, observed that Alp possesses the ability to comprehend abstract concepts, exhibits accelerated learning compared to his peers and demonstrates exceptional academic aptitude. Consequently, he was a highly driven, talented, and accomplished student. Alp displayed a remarkable level of openness and expressiveness, as well as a high degree of introspection. He articulated not only his "excellent ideas," but also his misgivings and uncertainties. His clear expression provided valuable insights into his cognitive processes in a coherent and verifiable manner.

In Turkey, sixth-grade students are expected to memorize and apply the divisibility rules of 2-3-4-5-6-9-10 without using a calculator (MoTNE, 2018a). In high school, students at the ninth-grade level are expected to memorize and apply the divisibility rules of 2-3-4-5-6-8-9-10-11-12-15 in mathematical problems (MoTNE, 2018b). In the curricula, students are expected to memorize the divisibility rules as in Figure 1. The same divisibility rules are included in science high school curriculum objectives at the ninth-grade level (MoTNE, 2018c). The divisibility by 7 and 13 are not included in both middle and high school teaching curricula in Turkey. This study was conducted before Alp's mathematics teacher covered division rules based on the science high school program. Before data collection, the teacher asked him what he knew about divisibility rules. Based on Alp's explanation, he learned the rules of divisibility for 3, 4, 5, 8, 9, and 10 by memorizing them in school beforehand. He learned the rules of divisibility for 7 and 11 from the internet, without knowing the underlying mathematical reasons.

Divisor	Rule
2	The last digit must be divisible by 2
3	The sum of the digits must be divisible by 3
4	The number formed by the last two digits must be divisible by 4
5	The last digit must be 0 or 5
6	The number must be divisible by both 2 and 3
8	The number formed by the last three digits must be divisible by 8
9	The sum of all digits must be divisible by 9

Figure 1. Summary of the divisibility rules in the textbooks

Data Collection

We gathered data using the teaching interview methodology, which enables the interviewer to delve deeply into the learner's thought process and didactical intents (Hershkowitz et al., 2001; Tsamir & Dreyfus, 2002). The teaching interview approach enables the researcher to thoroughly explore the learning process of a student when the learner exhibits constraints in their current cognitive patterns. Before starting the study, a preliminary interview was conducted with Alp to give information regarding the study. This meeting included information regarding the volunteer participant form and the family consent form. The University Ethics Committee and the Ministry of National Education provided the necessary approvals. The researcher and the teacher collaboratively devised the data collection process. The teacher acquired the interview data due to Alp's prolonged interaction with them. Data were obtained through two clinical interviews. We arranged the interviews based on the complexity of divisibility

rules. We chose divisibility by 3 as the initial conceptual milestone because of the student's prior familiarity with this rule during their middle school years. For the first interview, we prepared a worksheet (see Figure 2) that was derived from prior studies (Zazkis & Campbell, 1996; Zazkis et al., 2013). When creating the task, we considered three factors: (i) the questions should keep him in problem-solving efforts, (ii) he should use his prior knowledge as much as possible, and (iii) the abstraction should take place in the process. In this worksheet, we included problems related to divisibility by 3. We asked the first question to understand how he made a relationship between the digits of a number divisible by 3. The problems aimed to observe the processes of recognizing and building-with the information required for the relationship between the divisibility rule and place values of the digits of the number. After creating the numbers that can be divided by 3, he was expected to solve the problem by recognizing (e.g., division) and building-with (e.g., place value analysis) structures. The second and third questions were required to investigate the divisibility of a three-digit number (2a4 and 2aa) whose digits are given as unknown. We asked the fourth and fifth questions to find what kind of relationship there should be between the divisibility of the numbers of $2aa^2$ and 2a0b by 3. We used these questions to determine how the newly created mathematical structure can be used in complex situations. In addition, in the first interview, after the study of divisibility by 3, we examined how he approached other divisibility by 9, 11, 7, and 13, respectively. Following the analysis of divisibility by 3, we examined his construction of divisibility by 11 and divisibility by 7 during the initial interview. After evaluating the previous interview, we did not prepare a worksheet for the second interview. In this interview, we asked him to examine the rule of divisibility by 13, which was not in the Science High School Curriculum. He had no prior knowledge about divisibility by 13. In the interview, we expected that he generated this divisibility rule based on the information he had previously formed. In this context, it was aimed for him to *recognize, build-with, construct* and *consolidate* the information abstracted in the previous problem.

Worksheet

1. If a number is divisible by 3, what kind of relationship is there between the digits of the number?
   a) Write numbers that are divisible by 3.
   b) Write numbers that are not divisible by 3.
2. If the three-digit number 2a4 is divisible by 3, what is the relationship between the digits of the number and a?
3. If the three-digit number 2aa is divisible by 3, what is the relationship between the digits of the number and a?
4. If the three-digit number $2aa^2$ is divisible by 3, what is the relationship between the digits of the number and a?
5. If the four-digit number 2a0b is divisible by 3, what is the relationship between the digits, a and b?

Figure 2. Worksheet used in the first interview

The student was not subject to any time constraints throughout the interviews. Each interview lasted approximately 30 minutes. There was a one-day gap between the first and second interviews. During the interviews, Alp voiced his thoughts about his solution and also provided written explanations if he wanted to. In this sense, mathematical explanations and solutions written by the student while addressing the problems in the interview were also used as data sources. We recorded both interviews on audio with the permission of the participant and then converted them into written transcripts. Alp's written explanations and mathematical operations were included in the appropriate sections of the transcribed document.

In this study, the two researchers had similar and different roles. The first author of this study was the mathematics teacher of the gifted student Alp. She performed the interviews in this study. During the teaching interviews, the interviewer takes on the simultaneous responsibilities of both a teacher and a researcher. She posed questions to Alp with two main objectives: (i) to prompt Alp to elucidate his actions and their underlying rationale, and (ii) to stimulate Alp to contemplate his actions, thereby facilitating progress beyond his individual capacity. In particular, the first researcher allowed the student to construct knowledge based on his prior knowledge, provided guidance and hints, provided discussion environments, asked the student to explain his answers, questioned the student's answers, encouraged him to find alternative ways to solve problems, and supported him to use multiple representations. Moreover, in cases where Alp remained silent or did not explain his solution, the interviewer asked, "How did you come to this conclusion?", "I don't understand, can you explain how you did it?" and "I understood this situation like this, did I understand it correctly?" Since the interviewer was also the mathematics teacher of the gifted student Alp, the strong dialogue between the student and the teacher helped to ensure teacher-student interaction in the study. On the other hand, the second author of the study took an active role in constructing and analyzing the interview process according to abstraction theory.

Data Analysis

In this qualitative study, we examined the data (audio recordings, interviews, and written answers) based on the framework, the RBC+C model. According to the content analysis, we often included direct quotations in the findings. In the data analysis, firstly, we translated the audio recordings into written text to reveal Alp's actions in the abstraction process. Then, we added Alp's written answers to the relevant parts of the interview data. After transcription of the data, we examined the document carefully several times and divided it into meaningful sections based on the RBC+C model. In the light of the theoretical framework, we examined Alp's cognitive epistemic actions in the abstraction process under the themes of recognition, build-with, construction and consolidation. In Table 1, we presented an example coding of data related to the abstraction of divisibility by 11 based on

RBC+C model. To deepen the student's abstraction process, the findings were supported by direct quotations from the student's written and verbal explanations.

Table 1. Example of coding data

Name	Utterance	Epistemic actions
Researcher	Do you know the divisibility by 11?	
Alp	Yes, from the internet, I recall the rule being related to +,–,+,– and the number's digits. But I am not sure…	Recognizing
Researcher	What does it mean for a number to be divisible by 11?	
Alp	I can use the rule. +,–,+,–… [He is writing]	
Researcher	without breaking the rules?	
Alp	If a number is divisible by 11, it can be written as 11.k, like 11, 22, 33,... 99.	Building with
Researcher	For a three-digit number, abc, how can you explain why it is divisible by 11?	
Alp	Should I decompose it according to the place values?	Recognizing
Researcher	Do it if you want.	
Alp	Yes, 100a+10b+c= abc. We can write 100a as 99a+a. For 10b, what can I do? It would be great if this was 11b... [he pondered]. Should we write it like this? 10b+b? ... [Silence]	Building with
Researcher	Think about the place value of b in abc. What is it?	
	10b. It has to be 11b-b=10b. [He planned] abc=99a+11b+a-b+c. 99a and 11b are divisible by 11. The digits of numbers and signs are important for divisibility by 11.	Building with Constructing

This coding example in Table 1 illustrates how Alp constructed divisibility by 11 based on knowledge of divisibility by 3 that he had previously constructed. Alp recognized with the rule of divisibility by 11 on the internet as a remembered component (recognizing). The interviewer's question prompted him to acknowledge the relevance of multiplication and divisibility by 3 in the given setting (building with). Alp was in the early stages of abstracting for divisibility principles that rely on place value (building with). After remembering the role of place value in divisibility rules, Alp constructed the divisibility by 11 (constructing). The student's interview data and written solutions were cross-checked by two different researchers in line with the epistemic actions in the RBC+C abstraction model.

The validity of the research was first ensured by the variety of data. The interviews with the student, the researcher teacher's written notes, and the student's written solutions were used as data sources (Bogdan & Biklen, 2006). After the audio-recorded interview data were transcribed, the written texts were confirmed by the participant to ensure accuracy and consistency between their statements and what was written and to make peer assessments (Creswell, 2007). In this study, the gifted student was informed by the researcher teacher that these interviews were conducted only to understand what he was thinking in order to avoid grade anxiety. In this way, the validity and reliability of the study were tried to be increased by ensuring that the student clearly said what he thought. Moreover, to ensure validity and reliability in the study, a long-term interaction was formed between the participant and the researcher. Furthermore, we carried out the coding for the abstraction process in a separate and individual manner. In this study, we implemented observable epistemic actions, specifically recognizing, building-with, and constructing (RBC), for each divisibility rule in the sequence mentioned in the interview. The interrater reliability was computed using the formula developed by Miles and Huberman (1994). We have attained a level of consensus amounting to 83%. Subsequently, we reviewed the codes to achieve a comprehensive consensus.

RESULTS

Using Memorized Divisibility Rule through Numerical Reasoning

The researcher first asked Alp to give examples that are divisible by 3 and are not exactly divisible by 3. Meanwhile, Alp read the problem and made the following statements:

Alp: If a number is divisible by 3, when we add the digits of that number it should be a multiple of 3 like 21 or 321. If it is a very large number, we can find its divisibility by 3 if only the sum of its digits is divisible by 3.

While explaining the divisibility rule for 3, Alp focused on the sum of the digits of the number. At this point, Alp has not yet associated an expanded notation for the number with divisibility. On the contrary, he used a memorized rule that he knew from his previous lessons. The researcher asked Alp to find the possible values of a so that three-digit numbers $2a4$ and $2aa$ with unknown digits are divisible by 3. Alp made the following explanations:

Alp: Here, the sum of these $[2 + a + 4$ and $2 + a + a]$ must be a multiple of 3… When we add 2 and 4, we get 6. If it $[2 + a + 4]$ is a multiple of 3, here a could be 3, could be 6, or could be 9. It would be 3, 6, or 9 because a specifies a digit.

Alp carried out the operations without using pen and paper to find the divisibility of $2a4$ and $2aa$ by 3. He found all possible numbers like 3, 6, and 9 except 0. Alp reached an answer without difficulty using the memorized divisibility rule that he was familiar with. Therefore, Alp was not asked the third and fourth questions in Figure 2, which required Alp to apply the same process. In the interview, the researcher asked Alp the reason why the divisibility rule by 3 is related to the sum of the digits of the number. The following dialogue took place between the researcher and Alp:

Researcher	If you did not know the divisibility rule for 3 in any number or if I said as your teacher, "No, Alp, you are wrong, for a number to be divisible by 3, the sum of its digits does not have to be a multiple of 3", Do you give me an answer?
Alp	So… Can I think about it?
Researcher	Of course… Here is the pen and paper. You can write numbers or something if you want. Did you understand me?
Alp	Yes, I get it [he thinks]…
Researcher	You just said, "there are some numbers that are divisible by 3." For example, you said 21.
Alp	… [Silence]

As seen in the interview excerpt, although Alp correctly applied the rule he knew in the questions, he could not yet question the underlying meaning of this rule. At this point, the researcher asked again what it means for a number to be divisible by 3 to understand how Alp distinguishes numbers that are divisible by 3. The researcher also wanted to activate the questioning capacity of the student with this question. With this question, the researcher pushed the student to question the mathematics in the divisibility rule.

Researcher	What does it mean when a number is exactly divisible by 3?
Alp	It means a multiple of 3…
Researcher	What exactly does a multiple of 3 mean? For example, if we examine ab as a two-digit number or abc as a three-digit number… How will we decide whether these numbers are divisible by 3?
Alp	Is ab the number like a multiple of 3?
Researcher	a and b can be represented by various numbers.
Alp	ab must be a multiple of 3. So, they [a and b] must be certain digits. For example, 72, 75. For ab, we can write numbers that are multiples of 3 from 12 to 99 (see **Figure 3**).
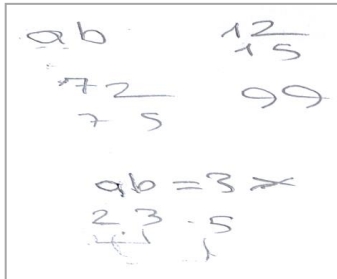
Figure 3. Alp's examples of numbers divisible by 3

The interview excerpt revealed that Alp recognized all two-digit numbers that are divisible by 3 because he focused on all two-digit numbers that are multiples of 3 instead of a few examples. This shows that he recognized his previous knowledge elements regarding the multiplicative structure of numbers and divisibility. Although he concentrated on specific, carefully selected examples as a result of his awareness of the need for generalization, he could not associate the divisibility rule for 3, which he had memorized yet, with the place value analysis (an expanded form of the number).

Abstraction of Divisibility Rule through Place Value Analysis

Since Alp could not establish a relationship between the expanded form of ab and its divisibility for 3, the researcher asked Alp whether he remembered how a number can be written as an expanded form. This question helped Alp relate place value to divisibility. In this way, he expressed the number in the form of $10a + b$ using the place values of a number ab. Then, Alp wrote the number as $9a + a + b$, thinking that for a number to be divisible by 3, it must be a multiple of 3. Thus, Alp discovered that the remaining number $a + b$ is critical in dividing by 3, as seen in the interview section below.

Alp	We have ab as a two-digit number. We do not know whether it is divided by 3 or not.
Researcher	We can focus on a and b. For example, is ab 3 times the sum of its digits?
Alp	The number can be a multiple of 3.
Researcher	Ok. Do you remember how to expand a number based on its digits?
Alp	[He writes an expanded form of the two-digit number ab on the paper] (see Figure 4-a).
Researcher	Is $10a$ a multiple of 3?
Alp	10 is not a multiple of 3. It depends on a.
Researcher	Well, can you make the number a multiple of 3?
Alp	If we add something like 3 next to it. We can write it as $9a + a + 1b$. Here, $9a$ is always divisible by 3. The second addend $(a + b)$ is the sum of the digits. Therefore, the number is divisible by 3 only if the sum of the digits is divisible by 3.

According to the interview excerpt, Alp used the knowledge of place value analysis with the guidance of the researcher. Then, he grouped the expanded form of the number as a multiple of 3 and focused on the remainder $a + b$. Thus, he explored the divisibility rule for 3 conceptually. One of the most important indicators of the formation of conceptual understanding was that Alp decided to use the place value analysis to question the division of a three-digit number abc by 3 (see Figure 4-b). This situation shows that Alp needed to construct a new structure to reveal the divisibility rule. This attempt of Alp was an action that showed that he was trying to abstract the structure he has constructed. After examining the divisibility of two and three-digit numbers by 3, Alp made sense of the rule conceptually that he previously memorized as "if a number is divisible by 3, the sum of the digits must be divisible by 3".

Figure 4. (a) Two-digit and (b) three-digit number analysis for divisibility by 3

Extending the Abstracted Structure to Other Divisibility Rules

During the interview process, Alp wondered whether he could create the divisibility rule for 11, as he had learned the divisibility rule by 3 conceptually. For the divisibility rule for 11, Alp decided to first use a two-digit number ab and then a three-digit number abc. Figure 5-a and Figure 5-b show Alp's operations while questioning the divisibility rule for 11. Alp's written explanations showed that he tried to generalize the divisibility of a number by 11, not just from a few examples, but using a two-digit number ab and then a three-digit number abc. At this point, Alp grouped the numbers he obtained through place value analysis to be a multiple of 11. Then, he made the rule of divisibility by 11 meaningful, which he stated that he remembered with symbols such as $+$ and $-$. Thus, for Alp, the procedural processes used in dividing a number by 11 (e.g., (i) writing the $+, -, +, -, \dots$ signs under the digits of that number, respectively, starting from the ones digit, (ii) adding the numbers in the plus groups among themselves and adding the numbers in the negative groups among themselves, (iii) taking the difference of these two sums and (iv) dividing this sum by 11.

Figure 5. (a) Two-digit and (b) three-digit number analysis for divisibility by 11

In the interview, after divisibility by 11, the researcher asked Alp about the rule of divisibility by 7, which is not in the science high school curriculum. Alp said that he had looked at the rule on the internet before, but he did not remember it exactly. At this point, Alp decided to use a three-digit number abc by performing a place value analysis to examine the divisibility rule for 7, as in Figure 6.

Figure 6. Alp's representations for the divisibility rule for 7

After Alp wrote the expression $98a + 7b + 2a + 3b + c$ and separated the multiplies of 7, he focused on the remaining $2a + 3b + c$. He discovered that the number abc is related to the coefficients $+1, +3, +2$, respectively. Alp generalized the situation with a pattern as in Figure 7 by using a number with a large number of digits to examine the situation.

$abcdefghı$ digits of the number	a	b	c	d	e	f	g	h	$ı$
Coefficients corresponding to digits	+2	+3	+1	-2	-3	-1	+2	+3	+1
The number in the digit is multiplied by the relevant coefficient and added. If the number found is divisible by 7, the number is divisible by 7.	$2a + 3b + c - 2d - 3e - f + 2g + 3h + ı$								

Figure 7. Working principle of the divisibility rule for 7

The Student's Abstraction of a Divisibility Rule Never Encountered Before

The second interview focused on the process of abstracting the divisibility rule for 13, which is not included in the science high school curriculum and Alp has no prior knowledge. How Alp handled the divisibility rule for 13 by using the expanded form of the number is presented below:

Researcher	In our previous meeting, we talked about divisibility by 3, 9 and 11 and 7. Now, we can focus on the divisibility rule for 13. If a number is divisible by 13, what do you say about this number?
Alp	I don't know anything about the divisibility rule for 13.
Researcher	Ok, now think about it!
Alp	We can examine it in the same way.
Researcher	Please. I give you as much time as you want.
Alp	Well. I try it for abc. I've grouped numbers here too. $97a$ [thinking]…
Researcher	Is $97a$ multiple of 13?
Alp	I will divide.
Researcher	Ok.
Alp	It will be $91a$. It is $91a + 9a$ (see Figure 8). Then, $10b$ is not divisible by 13. Let's write it as $13b - 3bs$. Also, c is not divisible by 13. If we write $13c$…No…wait a minute…$13c$…I mixed it. I couldn't remember how I did these in other divisibility cases.

Figure 8. Alp's analysis of divisibility by 13 using a three-digit number

Alp tried to find the divisibility rule for 13 from the way he had learned in the first interview. Therefore, he used his knowledge of place value analysis again. However, after grouping the numbers as the multiples of 13 (see Figure 8), he was confused because he needed to create a new structure for the divisibility rule for 13. Alp sensed that a three-digit number does not reveal the mathematical structure of divisibility by 13. This blockage forced Alp to remember the previous divisibility rule. For this, he decided to examine the divisibility rule for 11 again. In this way, the consolidation process emerged by repeating the structure acquired in previous learning in Alp's cognitive actions.

Alp	For the divisibility rule for 11, $99a + 11b + a - b + c$ [he wrote]
Researcher	When we looked at the divisibility by 13, what happened?
Alp	$9a - 3b + c$
Researcher	Ok. This is for a three-digit number, so how would we generalize if the number was four, five, or six digits? It's also divisible by 11 $+, -, +, -$. Well, what do you think comes in here? $+1, -3, +9, +1, -3, +9$ does it come? Or something else?
Alp	I think it could be like this. $+1, -3, +9$ then -27…though not so.
Researcher	Shall we try?
Alp	It can be four digits. $1000a$ [he divided 1000 by 13]. Then, $988a + 12a + 91b + 9b + 13c - 3c + d$ [he wrote]. $12a + 9b - 3c + d$
Researcher	Is a pattern forming?
Alp	Here…
Researcher	Can you write something instead of $12a$? Here are the coefficients $1, -3, 9$.
Alp	They were three times each other. They became -3, then $+3$. Then…

In this process, it was seen that Alp needed to examine how he found the previous divisibility rule for 11 while dealing with divisibility by 13. This behavior of Alp exemplifies the 'fragile' structure of newly created knowledge. Because the structure, that was just constructed, was not consolidated it caused difficulties in using this structure in future activities. Although Alp discovered that divisibility by 13 was different from divisibility by 11, he had difficulty in searching for the rule for divisibility by 13 with a three-digit number. At this point, the researcher offered Alp a clue to think about numbers with different digits. Thus, Alp realized that he needed to focus not only on a three-digit number but also on a four-digit number. Alp focused on the four-digit number $abcd$ (see Figure 9-a). Although Alp does a step analysis, he has not yet reached a clear rule for divisibility by 13. Meanwhile, Alp sensed that he had to go beyond the usual trials. After Alp's attempts failed, the researcher introduced a new guiding question and encouraged Alp to make a new attempt. Alp decided to focus on a five-digit number $abcde$ to investigate its

divisibility by 13 (see Figure 9-b). In the interview section below, it is seen how Alp abstracted the mathematics underlying the divisibility rule for 13.

Researcher	Shall we try another number?
Alp	[He considered the five-digit $abcde$ as in see Figure 9-b]. Divide 10000 by 13. We have 3 left. Then $1, -3, 9, 12, 3$. The first thing that happened. There are -3 and $+3$. Plus a…
	You can write $13b - b$ instead of $12b$.
Researcher	Yes… If we divide $1000b$ by 13, the remainder is $12b$. We can write $12b$ as $13b - b$. Then, we can write $-9a$ after we
Alp	divide 10000a by 13.
Researcher	Shall we arrange them?
Alp	Then $e - 3d + 9c - 1b + 3d - 9a$ [he wrote].
Researcher	How about the rule?
Alp	The numbers in the rule repeat every three digits, but first + then -, with opposite sign… $+1, -3, +9$ then $-1, +3, -9$ it happens.

Figure 9. Alp's (a) four-digit and (b) five-digit number analysis for the divisibility by 13

The Student's Attempt to Consolidate New Knowledge

Alp needed the guiding questions of the researcher while abstracting the divisibility rule for 13. After Alp constructed the divisibility rule for 13, he felt that the information he created needed to be verified. He decided to consolidate newly constructed knowledge. For this reason, Alp performed operations by taking a three-digit and a seven-digit number, which can easily be seen to be a multiple of 13, to show the correctness of the structure he found through the examples (see Figure 10-a and Figure 10-b).

Figure 10. Alp's test of the rule with (a) 3-digit number and (b) 7-digit number

In addition, when the researcher asked Alp what he thought about finding whether any number is divisible by 13 or not, Alp stated that he was sure of the mathematical correctness of the newly formed structure as follows:

Researcher	If I tell you a number, can you find out if that number is divisible by 13 using the rule you found?
Alp	In this way, we can find the rule for almost all of them. If we know how that number is resolved, we do not divide each number for no reason. Everything has an explanation. If I know [the divisibility rule], I can easily find the divisibility condition according to the rule and we gain practicality.

Alp tried to reconstruct the divisibility rules that he knew by heart before he started the abstraction process, based on his previous knowledge. In addition, Alp's progress in the abstraction process by determining a strategy showed that he was in the process of using the information. At this stage, Alp investigated the accuracy of the hypotheses he produced regarding the solution of the problem in the process of using it. Hence, Alp could consolidate the conceptual structure he learned by considering the divisibility rules in the curriculum (divisibility by 3, 9, and 11) and not in the curriculum (divisibility by 7 and 13). With the changes he made to the structures he knew, Alp was able to construct new meanings about the rules of divisibility by realizing the processes of creating and arranging the new structure required for each divisibility.

To conclude, Alp tried to reconstruct the divisibility rules that he had memorized before the abstraction process. In addition, Alp's progress in the abstraction process by determining a strategy (e.g., examining two-digit, three-digit numbers, if necessary, four- and five-digit numbers, grouping them according to the dividend number) showed that he was in the process of recognizing and building-with the information. At this stage, Alp investigated the accuracy of the hypotheses he produced regarding the

solution of the problem. As a result, Alp could consolidate the conceptual structure he learned by considering the divisibility rules (3-9-11) in the high school curriculum and (7 and 13) not in the high school curriculum. Thanks to the changes Alp made on the structures he knew, he could construct and arrange the new structure required for each divisibility. Thus, he could construct new meanings about divisibility rules.

DISCUSSION AND CONCLUSIONS

In this study, we examined a gifted high school student's abstraction process regarding divisibility rules. The results indicated that there are two important stages for abstraction: (i) the need for a new structure for abstraction to begin, and (ii) the emergence and consolidation of the new structure. In the first stage, Alp remembered the divisibility rules that he had memorized to solve the given problems. In the problem situation, when all the numbers in the digits were expressed with letters (e.g., abc), he had difficulty using the conceptual meaning of the rule of divisibility by 3 due to his rote learning. This finding supported Özçakır-Sümen's (2019) view that rote-based learning causes learning difficulties, that students cannot abstract the concepts they have memorized, and that not only unsuccessful students but also successful students experience these difficulties.

When Alp was asked about the reason for the divisibility rule by 3, he started to search for a new structure. This situation coincides with the assumption of Dreyfus et al. (2015) that the birth of abstraction begins with the need for a new structure. In addition, Alp's discovery that he can reach a general conclusion based on numbers in the problem without difficulty supports the conclusion that gifted students see generalizable conditions easier in problem solving (Girit-Yılmaz & Durmaz, 2021; İlgün et al., 2018). Abstraction arises from a need, and this is a mental process in the class that spontaneously comes true, difficult (Dreyfus et al., 2015). At this point, teachers' questions contributed to the student's need for abstraction. The researcher's prompts throughout the interviews aided the student's advancement in mathematical abstraction. Certain investigations asserted that students can generate knowledge when educators furnish the requisite assistance (Kobak-Demir & Gür, 2019; Williams, 2007). The findings of the current study corroborated the notion that the teacher plays significant and essential functions in the process of knowledge abstraction (Schwarz et al., 2009).

The results also indicated that Alp experienced uncertainties in the abstraction process of the divisibility rule by 3. However, it is not unexpected for students to give ambiguous, incomplete or incorrect answers while constructing knowledge (Bozkurt & Polat, 2018). Because in an unfamiliar situation, the need to act and uncertainty is high, and the capacity to pay attention to and remember the objects, features and events in the situation may be limited (Ozmantar & Monaghan, 2007). In such situations, it is not easy for the student to get out of this uncertainty without help. At this point, the researcher's questions have functions not only to evaluate the accuracy of the student's answers, but also to reveal the ideas of the students, support their thinking, enable them to share their thoughts verbally and aloud, and help them develop their conceptual understanding. Within the scope of this study, it has been observed that Alp, who is gifted, does not have difficulty in performing algebraic operations in the abstraction process, and even in some cases, he does operations without using pen and paper. However, in this process, the student needed the teacher's guidance as he had difficulty remembering and using some information. The teacher has an important role in the initiation and progression of the abstraction process. Thus, Alp's progress by using the given clues in structuring new knowledge has also been a result that supports the studies in the literature. Some studies also claimed that students can create knowledge when teachers provide necessary guidance (Kobak-Demir & Gür, 2019; Williams, 2007). The results of the present study supported that the teacher has important and necessary roles in the process of abstracting information (Ozmantar, 2004; Schwarz et al., 2009).

In the second interview, we found that although the student structured the knowledge through various divisibility rules, he could not easily transfer this knowledge to a new situation (e.g., divisibility by 13). This may be related to the student's inability to consolidate the newly formed knowledge (İlgün et al., 2018). However, since the student correctly formed the divisibility rule by 11, he could easily use this information while finding the divisibility rule by 13. This showed that he recognized the correct information while abstracting a divisibility rule that he had never known. This result supported the view that the student's previous learning affects the knowledge construction process (Dreyfus, 2007). Furthermore, students may feel the need to verify a newly discovered mathematical fact or idea (Dreyfus et al., 2015). Researchers state that for the abstraction of new knowledge, consolidation must occur (e.g., Monaghan & Ozmantar, 2006) to use the new knowledge in a new situation. In this study, Alp needed to show the correctness of the structure he created through examples after abstracting the divisibility rule by 13. Eventually, we observed that epistemic actions (recognizing, building-with, constructing, and consolidating) in the abstraction process are not independent of each other as mentioned in the results of some studies (Dreyfus, 2007; Hershkowitz et al., 2001; Kobak-Demir & Gür, 2019; Monaghan & Ozmantar, 2006).

In this study, the student's memorization of information created difficulties in remembering and using the information. For this reason, teachers should provide students with an opportunity to construct their own knowledge by guiding them rather than providing ready-made information. For this, in an inquiry-based learning environment, students focus on why and how questions. At this point, gifted students can be encouraged to question information more easily than other students. Gifted students can be allowed to construct knowledge through more challenging tasks. Gifted students are expected to work on difficult, interesting, challenging, and high-level tasks and questions (Aydemir-Özdemir & Işıksal-Bostan, 2021). This study also revealed that one of the factors that negatively affects the abstraction process was the lack of prior knowledge required for abstraction or memorized information. Therefore, before passing the abstraction processes, students' previous learning on the concepts can be checked. If

deficiencies are detected in the preliminary analysis, a preliminary study should be carried out to eliminate these deficiencies. In this study, we studied with only one gifted student. In future studies, researchers may examine how gifted and non-gifted students navigate the abstraction process together. They can analyze the effects of peer learning on the abstraction process among gifted and non-gifted students by analyzing the nature of the interaction between them.

LIMITATIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

While focusing only on a gifted student's abstraction process was a limitation because it restricts the ability to formulate generalizable conclusions, the results possess considerable significance for educators teaching gifted students in conventional classroom environments and those operating in SACs in Turkey. This study assists educators in creating assignments that consider the distinct needs of intellectually advanced children, with the goal of improving the quality of mathematics teaching in specialized academic centers (SACs). This study focused on a gifted student's knowledge construction processes about divisibility rules at different complexity levels. Despite the varying complexity levels of these divisibility rules, the methods used to uncover the underlying concept of each rule are similar. This similarity and the student's strong content understanding in algebra posed challenges in drawing a generalizable conclusion about the knowledge construction processes. Therefore, it is essential to analyze students' knowledge construction on tasks from different contents in mathematics. In the current study, the researcher plays a crucial role in the abstraction of knowledge. Future studies could investigate learners' knowledge construction processes both with and without the involvement of the interviewer to understand the role of the interviewer's guidance and support.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

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

Ethics Committee Approval Information

Ethical approval for the current study was taken from the Social Sciences & Humanities Ethics Committee at the University of Kastamonu (02/02/2022).

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| Research Article / Araştırma Makalesi|

Comparison of Face-to-face and Distance Education Based on Incremental Self-theory in terms of Students' Academic Achievement, Self-confidence, and Motivation and Teacher Views[1]

Gelişim Öz-teorisine Dayalı Yüz Yüze ve Uzaktan Eğitimin Öğrencilerin Akademik Başarısı, Öz-güveni ve Motivasyonu Açılarından Karşılaştırılması ve Öğretmen Görüşleri [1]

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Abstract

Purpose: This study aimed to compare the effects of implementing activities and materials designed according to incremental self-theory in face-to-face and distance education teaching the cell and divisions unit in the 7th-grade science lesson on students' academic achievement, self-confidence, and motivation. Another aim is to gather the science teacher's views about the implementation process.

Design/Methodology/Approach: In the research, a sequential explanatory design, which is a type of mixed research method in which quantitative and qualitative research methods are used together, was used.

Findings: As a result of the research, significant differences were found in favor of the students who received face-to-face education in terms of academic achievement levels, and the students who received distance education in terms of motivation levels. There was no significant difference between the two groups regarding self-confidence levels. The teachers, also, stated that the designed education positively affected students' morale, and motivation toward the lesson.

Highlights: Within the scope of the research, it may be helpful to integrate the teaching process, which is designed in line with the incremental self-theory and does not interfere with the curriculum of any lesson, into other lessons and subjects where students have learning problems and low motivation.

Öz

Çalışmanın amacı: Bu araştırmada, 7. sınıf fen bilimleri dersi hücre ve bölünmeler ünitesinin öğretiminde gelişim öz-teorisine göre tasarlanan etkinlik ve materyallerin yüz yüze ve uzaktan eğitimle uygulanmasının öğrencilerin akademik başarı, öz-güven ve motivasyonlarına etkisinin karşılaştırılması amaçlanmıştır. Diğer bir amaç ise, uygulama sürecine katılan fen bilimleri öğretmenlerinin görüşlerinin alınmasıdır.

Materyal ve Yöntem: Araştırmada, nicel ve nitel araştırma yöntemlerinin bir arada kullanıldığı karma araştırma yönteminin bir çeşidi olan sıralı açıklayıcı desen kullanılmıştır.

Bulgular: Araştırmanın sonucunda, akademik başarı düzeyleri açısından yüz yüze eğitim uygulanan öğrencilerin lehine, motivasyon düzeyleri açısından ise uzaktan eğitim uygulanan öğrencilerin lehine anlamlı farklılıklar tespit edilmiştir. Öz-güven düzeyleri açısından ise iki grup arasında anlamlı bir farklılık görülmemiştir. Öğretmenler ise, tasarlanan öğretimin öğrencilerin derse karşı moral ve motivasyonlarını olumlu yönde etkilediğini ifade etmişlerdir.

Önemli Vurgular: Araştırma kapsamında gelişim öz-teorisi doğrultusunda tasarlanan uygulama süreci oldukça kolay olan ve hiçbir dersin müfredatına müdahalede bulunmayan bu öğretimin, öğrencilerin öğrenme problemi ve motivasyon düşüklüğü yaşadığı diğer ders ve konulara entegre edilerek uygulanması faydalı olabilir.

INTRODUCTION

Since education has a highly interactive structure, it is a phenomenon that needs to be addressed together with the many elements it is related to (Bircan, 2018). In this context, efforts have been made to make education more qualified by considering the changing needs of the individuals who make up the society from past to present. In this regard, both the teaching programs and the strategies, methods, and techniques used have been tried to be developed through studies (Yıldız, 2016). Education is one of the services states must provide to their citizens in line with the principle of equality. In this regard, in case of geographical limitations, insufficient teachers, unsuitable learning environments, boarding education, bussed education, or distance education methods can be used to provide uninterrupted education. The distance education model is the most readily applicable of these methods as long as there is the necessary technical infrastructure (Kahraman, 2020).

In face-to-face education, the lessons specified in the curriculum are taught under the supervision of teachers, theoretically and practically, and in educational environments such as laboratories, classrooms, and workshops. In distance education, there is an educational method rather than an educational philosophy. The distance education process consists of a pre-prepared educational environment and teacher-student interaction. Technological developments also lead to significant consequences for the country and the result of the academic environment and interaction (Holmberg, 2005). Distance education students can continue regardless of location and time (Bates, 2005). Therefore, distance education contributes to equal opportunities in learning (Engelbrecht, 2005), and technology is a critical element of distance education (Bates, 2005). However, technological infrastructure and internet access may limit the fact that everyone can benefit equally from this education. Although the environments in which teachers and students are separated from each other are known as distance education, face-to-face meetings can be provided when necessary (Gunawardena & McIsaac, 2013).

Educational research adopted as face-to-face and distance application is conducted on various educational elements based on providing more effective and qualified education (Tutkun, 2010; Ural & Bümen, 2016). In this direction, many curriculums, teaching environments, models, and methods are developed and implemented (Nash, 2016; Nissim et al., 2016). In this context, one of the concepts that has emerged in recent years is the incremental self-theory. This theory is based on the view that a person's talent and intelligence level are characteristics that can be developed with sufficient and suitably focused effort (Boaler, 2013; Keenan, 2018; Orosz et al., 2017; Snipes & Tran, 2017). Individuals who believe that talents can be developed through good strategies, hard work, and the contributions of others have a growth mindset and tend to achieve more than individuals with a fixed mindset who believe talents are innate gifts (Dweck, 2016). According to Dweck (2016), this is related to individuals with a growth mindset focusing on learning rather than appearing bright. According to the incremental self-theory, not every individual is born with the same level of intelligence and talent. However, individuals with a growth mindset describe the difficulties they experience as opportunities for development and failures as helpful feedback to avoid making the same mistake again (Blackwell et al., 2007). In this context, it has been determined that a growth mindset increases the desire to learn (Burnette et al., 2020) and directs the person toward learning goals (Bempechat et al., 1991; Chen et al., 2020).

According to Dweck (2006), not only mental abilities but all human characteristics that people have can be improved with effort. Studies show that this belief of individuals who believe in the incremental self-theory affects their brain processes and closely affects their achievement (Mangels et al., 2006) and their ability to recover from mistakes by improving their awareness of mistakes (Moser et al., 2011; Schroder et al., 2017).

Incremental Self-theory and Science Education

In addition to having comprehensive content due to its structure, science education has a significant place in understanding and interpreting the natural world and creating critical and collaborative awareness in the light of scientific knowledge (De Melo et al., 2020). For this reason, the place of science subjects and concepts in the education process is essential. It is stated that the mindset, which is considered and discussed as an aspect of a person's identity in studies conducted within the framework of incremental self-theory, is an important variable that should be taken into account in future research on science and chemistry identity (Hosbein & Barbera, 2020). Spatz and Goldhorn (2021) found that incremental self-theory positively affects students' beliefs about learning physics. When taken together with the literature review results, all these issues show a need for new research to determine the effects of incremental self-theory on science and sub-disciplines.

In this research, which was conducted to determine the effect of applying this theory, whose effectiveness on learning has been demonstrated in line with the research in the literature, in face-to-face and distance education, activities designed according to the incremental self-theory within the scope of science lesson were applied both face-to-face and distance education. It has been determined that a few studies have been conducted in the domestic literature on incremental self-theory, especially in science education (Orhan & Aydın, 2021; 2022). There are many studies on this subject in the international literature, and new ones are added daily (King, 2020; O'Brien & Lomas, 2017; Rissanen et al., 2019; Seals, 2018; Sheffler & Cheung, 2020).

Confidence

One of the critical concepts reported to be influential on human behavior is self-confidence. Self-confidence, which is fundamentally rooted in one's self-respect, is one of the essential elements in attributing oneself as valuable (Malakcıoğlu, 2020). Heslin and Keating (2017) stated that concepts such as locus of control, self-esteem, self-confidence, and self-efficacy should be

considered to clarify the nature of the mindset. According to Dweck (2006), the self-confidence of people with a fixed mindset is more fragile due to the mindset they adopt in the face of problems and difficulties they experience.

Motivation

Motivation is one of the most critical factors affecting academic achievement (Mega et al., 2014; Robbins et al., 2006; West et al., 2016). The adopted mindset is reported to significantly affect the struggle, continuing the effort or giving up motivation, and reactions in case of failure (Dweck, 2000; 2006). Since individuals who believe in the entity self-theory believe that deficiencies in talent and intelligence are permanent, they define failure as a negative situation. They are negatively affected by it (Dweck et al., 1995). However, individuals who think that the characteristics in question can be improved are less affected by their failures because they define failure as an ordinary situation that may be encountered in the process (Aronson et al., 2002; Good et al., 2003). It is also reported that having a mindset that intelligence can be improved positively affects self-efficacy and motivation levels in addition to academic achievement (Bedford, 2017).

Similarly, Blackwell et al. (2007) also argue that students who focus on these potentials in line with the belief that intelligence can be developed will be positively affected in a motivational sense. Dinger and Dickhäuser (2013) state that the idea that intelligence can be developed will be beneficial in creating teaching environments that increase students' motivation. Similar studies in this direction show that adopting a growth mindset affects positively people through their motivational beliefs (Diseth et al., 2014; Ng, 2018; Rhew et al., 2018).

Importance of the Research

Throughout the historical process, many strategies, methods, and techniques have been used in the context of the education system, and new learning environments have made their importance felt in every period in line with the scientific and technological developments of the age and the changing needs of people (Yıldız, 2016). Since the education process is a service that the state provides equally to all its citizens, it is a necessary process that must continue uninterrupted. Especially in compulsory education, different methods such as bussed education, boarding school, or distance education can be used in places where educational institutions cannot be opened or when individuals cannot go to the educational institution. The easiest of these methods is the distance education model (Kahraman, 2020).

The method by which education and training activities will be carried out is determined and implemented within the framework of the education and training programs defined by the states within the scope of the education of their citizens. However, where the number of teachers cannot meet the number of students, increasing education and training costs, globalization, and the evolution of learning towards lifelong learning rather than a specific period may make distance education mandatory continuously or for particular periods (Urdan & Weggen, 2000). Recent extraordinary situations, such as epidemics and earthquakes..., similarly necessitate urgent distance education practices. Since distance education has become necessary, students' face-to-face and distance education views must be examined and evaluated in more detail on a lesson basis. Improvements must be made in the missing areas to make this education more useful to be carried out following its purpose and to eliminate the deficiencies compared to face-to-face teaching. As a result of the literature research, various studies were found in which student and teacher views were taken regarding the conduct of different lessons as distance education (Avcı & Güven, 2021; Aydın, 2022; Kahraman, 2020; Kan & Fidan, 2016; Karacaoğlu et al., 2021; Özkan, 2022; Pınar & Dönel-Akgül, 2020; Şirin & Tekdal, 2015; Yılmaz et al., 2021). However, no national or international study comparing the effects of applying incremental self-theory with face-to-face and distance education could be found. When the studies in the literature are examined, there are many studies with new ones being added day by day in the international literature on the incremental self-theory, which is described as one of the theories that are reported to be quite effective on various elements of education (Joo et al., 2019; Miyazawa, 2019) and it seems that these studies are pretty limited in the national literatüre. Therefore, this research is based on a self-theory that has been used limitedly in the national literature; unlike other studies, it is applied with two methods, face-to-face, and distance education, instead of a single application method, and the results are evaluated within the framework of academic achievement, motivation, and self-confidence, which can be considered among the essential elements in education. It fills a critical literature gap and provides valuable data to researchers who want to research this field later.

Purpose of the Research

This study compared the effects of implementing activities and materials designed according to incremental self-theory in face-to-face and distance education teaching the cell and divisions unit (CDU) in the 7th-grade science lesson on students' academic achievement, self-confidence, and motivation. Another aim is to gather the science teacher's views about the implementation process. For these purposes, answers were sought to the following research questions:

Instruction designed within the framework of incremental self-theory;

1. How do face-to-face and distance education impact students' academic achievement at CDU?

2. How do face-to-face and distance education impact students' self-confidence?

3. How do face-to-face and distance education impact students' motivation toward science learning?

4. What are teachers' views about implementing face-to-face and distance education?

METHOD

Model of the Study

The research used a sequential explanatory design, a mixed research method in which quantitative and qualitative research methods are used together. The first stage of the research was conducted with face-to-face education with 27 students studying at a public secondary school in the 2019-2020 academic year, and the last step was performed with distance education with 18 students studying at the same school in the 2020-2021 academic year, due to the COVID-19 pandemic. According to Creswell (2012), combining quantitative and qualitative methods in mixed-method research ensures a good understanding of the problem in the study. In the explanatory design, quantitative and qualitative data are collected sequentially in two stages (Creswell & Plano-Clark, 2015). In this design, primarily quantitative data is collected and analyzed, and then qualitative data is collected and analyzed. The analyses of the data obtained are interrelated and are usually combined in the interpretation and discussion sections (Baki & Gökçek, 2012). In this research, quantitative data were first collected and analyzed from face-to-face and distance education students. The findings obtained were explained and interpreted according to each research question. Qualitative data were then collected, analyzed, and interpreted by two teachers. In the last stage, the results obtained from the quantitative data were discussed, supported by qualitative data.

We used the quasi-experimental design with a pre-test and post-test control group in the quantitative part of the research, and we used the case study method in the qualitative aspect. A case study is a longitudinal approach that explains the current situation, examines and analyzes the communication between the factors affecting change and development, and shows the growth in the process (Best & Kahn, 2017). Quantitative research data were collected with the Cell and Divisions Unit Academic Achievement Test (CDUAAT), Self-confidence Scale (SCS), and Science Learning Motivation Scale (SLMS), and qualitative data were collected with a Written View Taking Form (WVTF).

Study Group

In determining the study group of the research, easily accessible case sampling was preferred because it provides practicality and speed to the study by quickly reaching the participants, saving energy, time, and financial resources (Bakırcı et al., 2016; Yıldırım & Şimşek, 2018). The research was conducted with students who continued their education activities in two 7th-grade branches of a public secondary school in a city center in the Western Black Sea Region. Among the reasons for choosing the 7th-grade level, it can be said that this age group is considered to be the period when secondary childhood ends and adolescence begins, and it is characterized as a period in which interpersonal relationships are developed. People focus on their search for identity (Selçuk et al., 2003). Additionally, some studies provide evidence that interventions aimed at creating a growth mindset are more effective at earlier levels of education (Ortiz-Alvarado et al., 2019). Therefore, it was decided that the 7th-grade level was suitable for this application, including interventions for students to develop a growth mindset.

The study group of the face-to-face application of the research, which was conducted in the first semester of the 2019-2020 academic year, consisted of students studying in the 7/F branch (N=27). In the application via distance education due to the COVID-19 pandemic, students studying in the 7/C addition (N=18) formed the study group. Branches were determined randomly. Information about the demographic characteristics of the study group is presented in Table 1.

Table 1. Demographic characteristics of students in the study group

		Gender			
	Branch	Female		Male	
		N	%	N	%
Face-to-Face Education	7/F	14	51.85	13	48.15
Distance Education	7/C	7	38.89	11	61.11

According to Table 1, 46.67% (21) of students are female and 53.33% (24) are male. The other research participants are two science teachers who participated in the face-to-face and distance education process with the students. Information about teachers is given in Table 2.

Table 2. Information about teachers

Teacher	Application Process	Branch
Teacher 1	Face-to-Face Education	7/F
Teacher 2	Distance Education	7/C

Data Collection Tools

The data collection tools used in the research are the Cell and Divisions Unit Academic Achievement Test (CDUAAT), Self-Confidence Scale (SCS), Science Learning Motivation Scale (SLMS), and Written View Taking Form (WVTF) used to obtain teachers' views about these practices.

Cell and Divisions Unit Academic Achievement Test (CDUAAT)

Researchers developed CDUAAT to determine the knowledge levels of students receiving face-to-face and distance education about CDU before and after the designed application within the scope of the relevant unit. CDUAAT has been prepared by considering the achievements of the appropriate team. Information regarding the validity and reliability of CDUAAT developed in this context is presented under the headings below. To determine the construct validity of CDUAAT, the achievement test was applied to 185 students from the 8th grade who were not included in the research group, and the obtained data were analyzed. CDUAAT was examined in terms of item discrimination and item difficulty values, and considering that five questions were easy and had low bias, it was deemed appropriate to remove them from the test in line with expert opinion, and they were reduced from 25 questions to 20 questions.

CDUAAT test items were prepared based on eight achievements determined for the unit discussed and contain 25 questions. Within the framework of content validity, the test was subjected to necessary corrections in line with the expert views and suggestions of two science teachers and two faculty members. As a result of the construct validity study, CDUAAT was reduced to 20 questions and was finalized to include at least one question for each outcome, thus ensuring both content and construct validity. The achievements associated with each question in CDUAAT (MoNE, 2018) are given in Table 3.

Table 3. Distribution of each question in CDUAAT according to acquisitions

Subject	Acquisition	Question Number	Total
1. Cell	Compares animal and plant cells in terms of their essential parts and functions.	2, 3, 4, 8, 16	5
	Discusses views on the cell structure from past to present, relating them to technological developments.	5	1
	Explains the cell-tissue-organ-system-organism relationship.	6	1
2. Mitosis	Explain the importance of mitosis for living things.	7, 13	2
	Explains that mitosis consists of different stages that follow each other.	10, 18	2
3. Meiosis	Explain the importance of meiosis for living things.	1, 9	2
	Shows on the model how meiosis occurs in reproductive mother cells.	17, 20	2
	Compares the differences between meiosis and mitosis.	11, 12, 14, 15, 19	5
		Total	20

In evaluating the questions in CDUAAT, questions answered correctly were scored 1 point, and questions left blank or answered incorrectly were scored 0 points. The data obtained from the developed test was subjected to reliability analysis with the SPSS 28.00 statistical package program, and the results are presented in Table 4.

Table 4. Reliability analysis data of CDUAAT

N	$\bar{X}$	Median	Sd	Average Difficulty (p_j)	Average Discrimination (r_j)	Reliability (KR-20)
20	13.14	20.49	4.53	.62	.56	.88

According to Table 4, it was determined that the r_j value of the developed achievement test was .56, the pj value was .62, and the KR-20 reliability value was .88. The test was deemed appropriate to be used in the research in its final form. In this context, it is stated that for the designed test to be considered a reliable test, the reliability value of that test must be .70 and above (Büyüköztürk, 2011).

Self-confidence Scale (SCS)

Self-confidence Scale (SCS) was introduced to the literature by Akın (2007). It contains 33 five-point Likert-type items, including internal self-confidence (17) and external self-confidence (16), in response to the items on the scale, 1=Never, 2=Rarely, 3=Often, 4=Usually, and 5=Always. According to this scoring, a minimum of 33 and a maximum of 165 points can be obtained from the scale. The Cronbach Alpha value of the scale was determined as .91 by Akın (2007). For this research, the scale was applied to 185 8th-grade students who were not included in the study group, and the reliability value was recalculated as .95 and used in the research.

Science Learning Motivation Scale (SLMS)

SLMS was developed by Dede and Yaman (2008) to determine students' motivation levels for learning science. The scale contains a total of 23 items in a five-point Likert type. In response to the items on the scale, 1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, and 5=Strongly Agree. While the maximum score that can be obtained from the scale is 115, the minimum score that can be obtained is 23. According to the results of the exploratory factor analysis conducted to determine the scale's

validity during the development phase, it is reported that the factors explain 47% of the total variance in the five-factor scale. In this regard, the scale's reliability coefficient value (Cronbach Alpha) was determined to be .80 (Dede & Yaman, 2008). Necessary permissions were obtained for the use of SLMS within the scope of the research. A preliminary application was made with 185 8th-grade students not included in the study group. Its reliability was found to be .89. It was deemed appropriate to use SLMS in this form in the research.

Written View Taking Form (WVTF)

The teachers' views in the groups where the teaching was designed according to face-to-face and distance education based on the incremental self-theory was implemented, regarding this process after the implementation was completed, were taken with the prepared WVTF. Expert opinion was born for this open-ended question, designed before taking the teachers' views, and the necessary arrangements were made in line with their suggestions. Questions are "What are your thoughts about the applicability of the prepared activities? Can you evaluate the changes you noticed in your students after the application?".

Design of the Application

To determine the effect of the face-to-face and distance education applications of the activities prepared based on the incremental self-theory on students' academic achievement, self-confidence, and motivation toward science learning in the relevant unit, it was deemed appropriate to carry out the application period for five weeks, four lessons per week, and 20 lesson hours in total. In both applications, the lessons were taught by the course teacher and the researcher. In this way, it was tried to make the students feel comfortable, and it was aimed to minimize the effect of the researcher.

Design of Face-to-Face Education Application

The face-to-face application phase of the research was conducted in the first semester of the 2019-2020 academic year. The face-to-face application was completed during the research process, where the science lesson was designed and implemented within the scope of CDU. It aimed to identify possible deficiencies and determine the feasibility and effectiveness of the planned activities. The face-to-face application process of the research is shown in Figure 1.
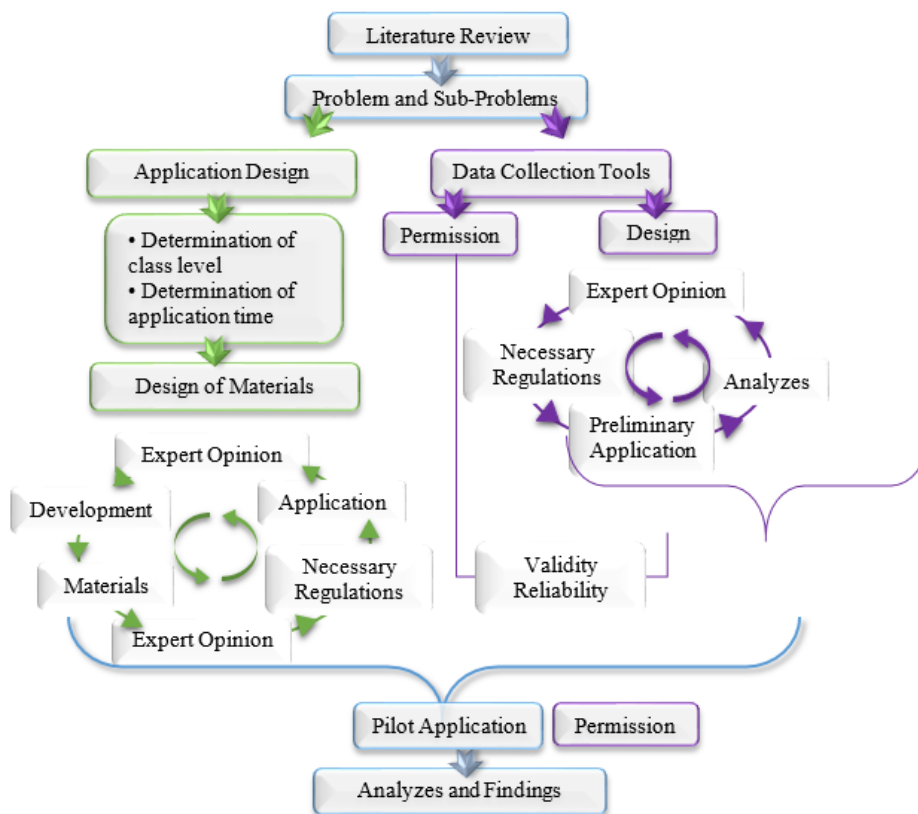
Figure 1. Face-to-face education implementation process

As seen in Figure 1, the measurement tools were first applied as a pre-test to the students in the 7/F branch, where face-to-face application was carried out. Later, in addition to the 2018 Science Curriculum, activities and materials designed based on incremental self-theory were used. After the application, the same tests and scales were applied again as a post-test. After the face-to-face education process was completed, the COVID-19 pandemic emerged. In this regard, adaptation and updating studies were carried out on the current situation after determining the situation and expert views.

Design of Distance Education Application

The measurement tools used in face-to-face application, lesson plans designed for students in the 7/C branch designated as distance education, and additional materials have been updated to be integrated into distance education. In this regard, the scales used within the scope of the research were converted into a format that can be applied in distance education via the Microsoft Office Forms program. The process followed in distance education application is given in Figure 2.
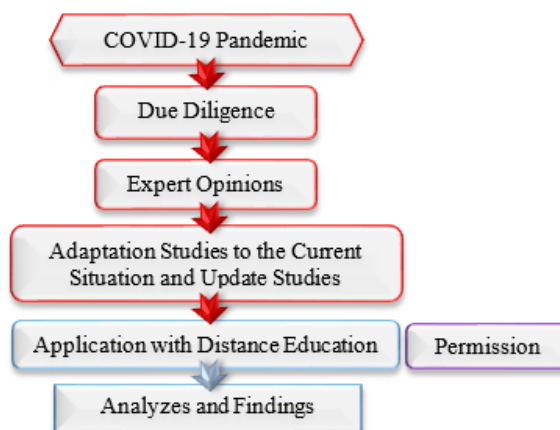
Figure 2. Distance education implementation process

In line with the process specified in Figure 2, the implementation phase for distance education was carried out with students studying in the 7th grade in the secondary school, where face-to-face application was carried out in the first semester of the 2020-2021 academic year. The process was carried out as specified in the face-to-face application, and unlike the face-to-face application, activities, and materials adapted to distance education were used. Examples of activities and materials used in both face-to-face and distance education are given below.

Feedback Sentences

Feedback sentences are frequently used in learning environments, provide information about the learning process to both the teacher and the student, and are very effective on students (Peker, 1992; Sönmez, 1994). As an example of the feedback to be given within the scope of incremental self-theory, Dweck (2006) suggests giving the following types of feedback to students who choose a challenging project in science class;

"I love that you chose a challenging project in science class. You will have to work hard; You'll need to research, design tools, get the necessary parts, and set up experiments. You will learn so much, amazing things…"

For questions that students solve quickly, it is recommended to use feedback of the type given below. According to Dweck (2006), lowering the bar so students can solve questions more efficiently does not make students more successful. In this context, it is recommended that students be given similar feedback as stated below.

"I guess this was very easy for you. Sorry for wasting your time. Let's learn something new."

For the same purpose, the use of feedback sentences for face-to-face and distance education students, which are stated below, may prevent students from adopting a growth mindset and encourage them to think with a fixed mindset by praising their intelligence when their efforts should be applauded, has been avoided.

- That was an intelligent answer, congratulations.
- You are brilliant, well done.
- …… your friend was brilliant and could solve the question immediately.
- The most brilliant student in this class…

Role Model Activities

The successes, efforts, and life stories of individuals defined as role models inspire many others (Dweck, 2006). Within the scope of the cell and divisions unit, role model activities designed according to incremental self-theory were used to help students develop growth mindsets. In this context, four people were identified, each of whom can be considered a role model in their field. These are American inventor and businessman Thomas EDISON, Joanne Kathleen ROWLING, author of the fantasy novel series Harry Potter, famous Physicist Albert EINSTEIN, and American voice actor, animator, producer, screenwriter, and director Walt DISNEY. A poster was designed containing statements about the failures these individuals, each defined as geniuses in their fields, had to struggle with before achieving these successes (Figure 3).

Figure 3. Example of a poster prepared for the role model activity

Cartoons

A platform called Class Dojo was used for the cartoons used within the scope of the application. Briefly, Class Dojo is an open-access communication platform for teachers, students, and families, where students create communities by sharing what they have learned in class through messaging, pictures, and videos when they go home. There are also cartoons on this platform aimed at developing a growth mindset. The researcher translated these cartoons, whose original language was English, and the translated expressions were added to the cartoons as speech bubbles. An example of Class Dojo is shown in Figure 4. The cartoons, rearranged in this form and consisting of five parts, have been uploaded to the channel created on YouTube and made available to the user, and the links to the cartoons are given below.

- Section 1: https://youtu.be/iNd1FEkQHhY
- Section 2: https://youtu.be/WYXxVDnBakE
- Section 3: https://youtu.be/FG3fBdCK3SU
- Section 4: https://youtu.be/NSV2cJSIKAI
- Section 5: https://youtu.be/9C6ZZMXh0ho

For several weeks we followed the stories of Moto, Keyti and Brus in Class Dojo. In the first episode, Moto was considering dropping out of school because he thought he wasn't smart enough. But now he knows what to do.

So do you know? What will you do if you fail at anything from now on?

Figure 4. Example of Class Dojo

In the face-to-face application, the cartoons were watched in the classroom via an interactive whiteboard (Figure 5). In the distance education application, they were transferred to the students' screens via desktop sharing.

Figure 5. Students watching Class Dojo in face-to-face practice

Additional materials.

Some additional materials have been designed to support students in developing a growth mindset within the scope of incremental self-theory. These are materials such as bookmarks (Figure 6) and personalized notebooks (Figure 7), which contain motivating expressions to develop a growth mindset and consist of Class Dojo characters that students follow.
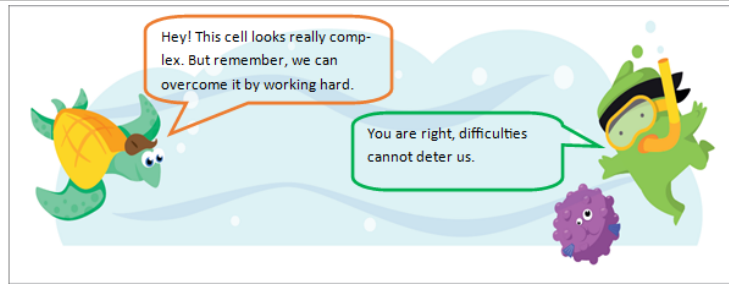
Figure 6. Example of bookmarks
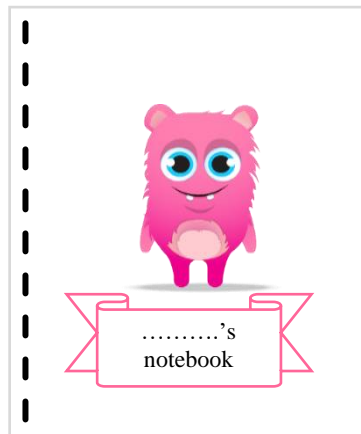
Figure 7. Example of notebook

These additional materials, which are always at students' disposal and designed according to the incremental self-theory, aim to contribute to their development of a growth mindset. Instead of these materials given directly to students in face-to-face education, posters designed as online materials were used in distance education, as seen in Figure 8.

Figure 8. Poster study used in distance education

How to Conduct Lessons?

Data regarding teaching courses within the scope of the application carried out face-to-face in the first semester of the 2019-2020 academic year and with distance education in the first semester of the 2020-2021 academic year are presented comparatively in Table 5.

Table 5. Delivery of lessons

Application	Application Time (Class Hours)	Teaching
Face-to-face education	20	Instruction designed according to incremental self-theory in addition to the existing curriculum
Distance education	20	Instruction designed according to incremental self-theory in addition to the existing curriculum

According to Table 5, in addition to the curriculum determined for the relevant academic year, the courses were taught with the course teacher and the researcher, supported by activities prepared based on the incremental self-theory and materials designed in this direction. In this way, it was tried to make the students feel comfortable, and it was aimed to minimize the researcher's influence. In this context, the suggestions of the teacher, who was informed about the incremental self-theory before the application, were considered throughout the process, taking into account the knowledge and experience of the students in the class. After the application was completed, the measurement tools were applied as a post-test, and the application process was completed.

Analysis of Data

The research used CDUAAT, SCS, SLMS, and WVTF measurement tools. The scores obtained from the CDUAAT, SCS, and SLMS tools were adapted to a 100-point system to present an average score for the data collection tools used and to provide the reader with the opportunity to comment in line with a standard evaluation scale (Berk et al., 2020; Comba, 2018). Accordingly, a minimum of 0 and a maximum of 100 from CDUAAT; A minimum of 20 and a maximum of 100 points can be obtained from SCS and SLMS.

The pre-test and post-test data obtained were analyzed to examine face-to-face and distance education applications in terms of application type. To determine the statistical analysis method, normality distribution, and variance homogeneity tests were used for the data. Kolmogorov-Smirnov normality analysis test results of the data are given in Table 6.

Table 6. Kolmogorov-Smirnov normality analysis results

Scale/Test	Pre-test/ Post-test	N	$\overline{X}$	Sd	*p*
CDUAAT	Pre-test	45	40.36	1.58	.123
	Post-test	45	76.44	2.86	.002*
SCS	Pre-test	45	85.87	1.43	.079
	Post-test	45	89.18	1.84	.001*
SLMS	Pre-test	45	83.87	1.18	.200
	Post-test	45	88.71	1.37	.001*

*p<.05

According to Table 6, it was determined that the distribution of the CDUAAT, SCS, and SLMS pre-test data among the data obtained from the measurement tools used within the scope of the research was normal (p> .05). In contrast, the distribution of the CDUAAT, SCS and SLMS post-test data was not expected (p< .05). The same data sets were subjected to the variance homogeneity test and the results are given in Table 7.

Table 7. Variance homogeneity test results

Scale/Test	Pre-test/ Post-test	Levene	df1	df2	*p*
CDUAAT	Pre-test	10.322	1	43	.002*
	Post-test	16.244	1	43	.001*
SCS	Pre-test	1.977	1	43	.167
	Post-test	4.114	1	43	.049*
SLMS	Pre-test	0.100	1	43	.753
	Post-test	3.508	1	43	.068

*p<.05

According to Table 7, it can be seen that the variance of the CDUAAT pre-test, post-test, and SCS post-test data is not homogeneous (p< .05), while the variance of the SLMS pre-test, post-test, and SCS pre-test data is homogeneous (*p*> .05). When Tables 10 and 11 are examined together, it can be seen that the distribution of the pre-test data obtained with CDUAAT is normal (*p*> .05), the distribution of the post-test data is not normal (*p*< .05) and their variances are not distributed homogeneously.

When the literature is examined, the Quade test, a non-parametric test used to analyze random full-block designs based on the Quade method, is used in cases where homogeneous variance conditions are not met (Cangür et al., 2018). Qualitative data obtained from teachers are stated by direct quoting.

FINDINGS

The data collected with the measurement tools used in the research were analyzed, and the findings obtained as a result of this process are presented below, under headings and associated with the relevant research question.

Findings Regarding the First Research Question

The first research question is about determining the effect of implementing instruction based on incremental self-theory through face-to-face and distance education on students' academic achievements at CDU. Quade test was used to determine whether there was a significant difference in application type within the scope of CDUAAT scores, and the data obtained through the analysis are presented in Table 8.

Table 8. CDUAAT quade test results

Scale/Test	F	df*H*	df*E*	*p*
CDUAAT	5.283	1	43	.026

According to Table 8, it was determined that there was a statistically significant difference between students receiving face-to-face and distance education when CDUAAT pre-test scores were kept under control (p < .05). Although the Quade test does not have a precise measure within the scope of effect size, various calculation methods that can be used in some studies are reported in the literature (Mursadin, 2020). An *r*-effect value of 0.1, evaluated independently of its sign and takes a value between 0 and 1, is considered small, 0.3 is considered medium, and 0.5 is considered significant (Field, 2009). Accordingly, the *r* effect value was calculated as 0.497 (high), and the effect explains 24.7% of the total variance (r^2). The difference detected as a result of the Quade test shows that the application of materials and activities designed according to the incremental self-theory in face-to-face and distance education for students to develop a growth mindset has an impact at a level that will create a statistically significant difference within the scope of the scores obtained with CDUAAT. For the details of this detected difference, the paired comparison test results of the groups calculated within the size of the Post-Hoc test are presented in Table 9.

Table 9. CDUAAT pairwise comparison test results

Scale/Test	Comparison	df	t	*p*
CDUAAT	distance education – face-to-face education	43	-2.299	.026

According to Table 9, it can be seen that the CDUAAT academic achievement levels of students receiving face-to-face education are higher than those of students receiving distance education. It shows that the activities and materials designed in this context increase the CDU academic achievement levels of the students in the face-to-face application group at a level that creates a statistically significant difference compared to the students in the distance education application group (*p*< .05).

Findings Regarding the Second Research Question

The second research question examines the effects of face-to-face and distance education implementation of instruction designed based on incremental self-theory on students' self-confidence. The findings obtained through the Quade test applied to determine whether SCS creates a significant difference in terms of application type in both face-to-face and distance education applications are presented in Table 10.

Table 10. SCS quade test results

Scale/Test	F	df*H*	df*E*	*p*
SCS	.845	1	43	.363

According to Table 10, it was determined that there was no statistically significant difference (*p*> .05) when the SCS pre-test scores of students receiving face-to-face and distance education were kept under control. As a result of the calculations (Mursadin, 2020), the *r*-effect value was calculated as 0.163 (low), and the effect explains 2.7% of the total variance. The Quade test result shows that distance and face-to-face education instruction practices designed based on incremental self-theory do not impact at a level that will create a statistically significant difference within the framework of SCS scores. For the details of the Quade test performed, information on the paired comparison test results of the groups within the scope of the Post-Hoc test is given in Table 11.

Table 11. SCS Pairwise Comparison Test Results

Scale/Test	Comparison	df	t	*p*
SCS	distance education – face-to-face education	43	.919	.363

According to Table 11, it was determined that the self-confidence levels of students receiving distance education were higher than those of students receiving face-to-face education, but this was not at a level that would constitute a statistically significant difference (*p*> .05).

Findings Regarding the Third Research Question

The third research question examines how implementing instruction based on incremental self-theory through distance and face-to-face education affects students' motivation toward science learning. The findings obtained by the Quade test applied to determine whether the SLMS creates a significant difference in terms of application type in both face-to-face and distance education applications are presented in Table 12.

Table 12. SLMS quade test results

Scale/Test	F	df*H*	df*E*	*p*
SLMS	4.228	1	43	.046

According to Table 12, it was determined that there was a statistically significant difference between face-to-face and distance education students when the SLMS pre-test scores were kept under control (*p*< .05). As a result of the calculations (Mursadin, 2020), the *r* effect value was calculated as 0.211 (close to the medium level) and the effect explains 4.5% of the total variance. This difference from the Quade test shows that the teaching designed according to the incremental self-theory, implemented through distance or face-to-face education, has an effect at a level that creates a statistically significant difference within the framework of SLMS scores. For the details of this critical difference, the paired comparison test results of the groups calculated within the scope of the Post-Hoc test are presented in Table 13.

Table 13. SLMS paired comparison test results

Scale/Test	Comparison	df	t	*p*
SLMS	distance education – face-to-face education	43	2.056	.046

According to Table 13, the motivation levels of distance education students for learning science are higher than face-to-face education students. It shows that the activities and materials designed in this context increase students' motivation levels in the distance education group for learning science to a level that creates a statistically significant difference compared to the students in the face-to-face education group (*p*< .05).

Findings Regarding the Fourth Research Question

The fourth research question is about obtaining teachers' views on whether the teaching designed based on incremental self-theory should be implemented face-to-face or through distance education. WVTF was applied to teachers in both face-to-face and distance education applications and was reached through Microsoft Office Forms. Data obtained from WVTF are presented in Table 14.

Table 14. Teachers' views about the practice

Teacher	Application Process	View
Teacher 1	Face-to-Face Education	*"I think it positively affects students' interest, morale, and motivation in the course."* *"Regarding applicability, it does not take much time, and I think it is useful."*
Teacher 2	Distance Education	*"The activities can be implemented easily. I saw that it had a motivational and motivating effect on students. The students in the class where I applied the study gave feedback, saying, "I'm glad we did this study. I believe I can succeed now."* *"It will be beneficial, especially in classes with low motivation."*

According to Table 14, teachers stated that they found this implementation process, in which they were involved personally, beneficial for the students. They mentioned that the designed teaching can be easily implemented in face-to-face and distance education. Considering that teachers are one of the main elements of the education and training process and factors such as their experience in this context and their knowledge of the students in the classroom, their views on the practice are critical in research.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This research aims to compare the effects of the application of materials and designed activities based on the incremental self-theory in the teaching of CDU, which is included in the 7th-grade science curriculum, in face-to-face and distance education, on students' academic achievement, self-confidence, and motivation toward science learning. In addition, science teachers were both personally involved in the implementation process, and their views on the designed teaching and process were tried to be determined.

The research determined that the application of materials and design activities based on students' incremental self-theory as face-to-face and distance education had a statistically significant difference in favor of students receiving face-to-face education within the framework of CDUAAT scores. Within the scope of the Post-Hoc test applied regarding this considerable difference, it was determined that the CDU academic achievement levels of students who received face-to-face education were higher than those who received distance education. When the studies in the literature were examined, no study similar to this study could be found. However, when we look at the research that includes comparisons of face-to-face and distance education in general, Okan (2020) compares the efficiency of undergraduate students within the framework of online lessons during the pandemic period and their comparison with face-to-face lessons found that face-to-face classes are generally more efficient and effective. Ozüdoğru et al. (2021) in their research, they discussed the comparison of distance education environments and face-to-face education environments in physiotherapy and rehabilitation education during the COVID-19 pandemic. As a result of their study with college students, they found that the perception of face-to-face teaching in the general score and all sub-dimensions was significantly higher than the perception of distance education. Yiğit et al. (2012), in their study comparing the achievement of students in distance education and face-to-face education, found a significant difference in the achievement levels of the lessons within the framework of "use of basic information technologies" given in face-to-face and distance education in favor of the students receiving face-to-face education. Yakışan and Ateş (2022) found that, as a result of their research comparing the effect of listening studies conducted in face-to-face education and distance education on achievement and permanence, they discovered that face-to-face hearing studies were significantly different in terms of student achievement as well as permanence of learning compared to those conducted remotely. However, there are also studies showing that distance education is effective. As a result of the research comparing web-based distance education and face-to-face education within the framework of the "Internet Programming-2 course", Balaman (2018) stated that web-based distance education is more successful than face-to-face education in ensuring permanence and increasing achievement.

The study was investigated to determine the effect of activities designed for CDU on students' self-confidence based on incremental self-theory. As a result of the research, it was determined that the self-confidence levels of students receiving distance education were higher than those of students receiving face-to-face education, but this was not at a level that would create a statistically significant difference. As a result of the research on the views of secondary school students regarding the digital materials used in science lessons during the COVID-19 pandemic, Paşa and Çelik (2022) concluded that distance education, which has become essential due to the COVID-19 pandemic, enables students to express their ideas more efficiently compared to traditional classroom environments. They reported that it also contributed to their increase in self-confidence by providing the necessary climate for self-confidence. In his research on the adaptation of faculty members working in vocational schools during the distance education process, Öztürk (2021) stated that most participants were not affected in terms of self-confidence during the distance education process.

While the application of the materials and activities designed in the research through distance or face-to-face education did not have a statistically significant difference within the scope of SCS scores, it has been determined that the implementation of activities and materials designed according to the incremental self-theory in face-to-face and distance education has an effect at a level that creates a statistically significant difference within the framework of SLMS scores. Within the scope of the Post-Hoc test conducted regarding this considerable difference, it was determined that the motivation levels of students who received distance education for learning science were higher than those who received face-to-face education. In addition, since information and communication technologies are generally described as enjoyable by individuals, they are reported to effectively increase students' motivation for the lesson when used for educational purposes (Balaman, 2018). Yiğit et al. (2012) stated in their study that technological tools are the only common link between students and teachers who prefer not to attend synchronous classes. Researchers have examined this issue through telephone, computer, and e-mail. Processes include teacher and student communication, mutual expression of views about the lesson, teaching and directing the classes and tracking the homework. They explained that it can be carried out through technological elements.

Additionally, it has been reported that answering students' questions via message boards can effectively increase students' motivation towards the lesson (Deka & McMurry, 2006). In their research on the effects of distance education on students' academic motivation levels for Turkish lessons, Orhan and Demir (2022) stated that students were more motivated to succeed in Turkish classes in distance education. When the studies on the effectiveness of distance education in the literature were examined, studies other than the results obtained from this study were also found. In his research, Duman (2020) stated that communication decreases in distance education, and students face motivation and focus problems.

In the study, in addition to the researcher, two science teachers were also involved in the application process, and their views about the applications were taken. In face-to-face education, teacher-1 and in distance education, teacher-2 were involved. Teacher-1 expressed her opinions about the effects of face-to-face activities developed based on incremental self-theory on

students, and teacher-2 expressed her views about the impact of implementing these activities through distance education on students. Teacher 1 mentioned that the activities developed based on incremental self-theory effectively increased their interest in the lesson, motivation, and morale. She also stated that these activities take little time in the implementation phase and can benefit the students. Teacher 2 noted that the activities developed according to the incremental self-theory can be easily applied to students in teaching relevant subjects. She mentioned that these activities have a motivational and motivating effect on students. She also stated that the students loved these activities very much and that they no longer had difficulty and could succeed. She noted that these activities could be helpful, mainly in low-motivation classes.

Both teachers agreed that these activities benefitted the students and were designed according to the incremental self-theory in face-to-face and distance education. As a result, using face-to-face activities and materials designed based on incremental self-theory in CDU teaching increases students' academic achievement compared to distance education. At the same time, motivation levels for learning science are higher in distance education applications. This result may be because, in academic achievement, they can solve more problems in the classroom environment, ask questions, and do experiments and activities when necessary. In motivation, using distance education tools such as computers is enjoyable for students. They can access the activities more efficiently. They can watch them over and over again when necessary. Students' self-confidence remained the same in both face-to-face education and distance education. This result may be because some concepts in the science lesson are abstract, and students think they cannot learn these concepts and are discouraged from learning them. Another factor may be the negativities brought about by the COVID-19 pandemic process.

This study was conducted with secondary school students. Similar analyses can be performed with primary, high school, and university students, and face-to-face and distance education can be compared. Similar studies can be conducted in which the views of parents, who are essential stakeholders in education and training, are taken, especially in distance education studies. During the distance education application process of the research, some students had only one computer at home, and their classes conflicted with their siblings, causing low participation. For this reason, researchers working with distance education should consider the socio-economic status of the target audience they will apply, the nature of the technological tools they use, and their access to these tools. Within the scope of the research, it is thought that it would be beneficial to integrate the teaching, which is designed in line with the incremental self-theory, with a straightforward application process and does not interfere with the curriculum of any lesson, into other classes and subjects where students experience learning problems and low motivation.

Declaration of Conflicting Interests

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Statements of publication ethics

We declare that the study has no unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

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

Ethics Committee Approval Information

Ethics committee permission for this study was obtained from the Kastamonu University Social and Human Sciences Research and Publication Ethics Committee with the decision dated on October 12, 2020, and numbered 3/14.

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| Research Article / Araştırma Makalesi|

Comparative Analysis of the 2018 and 2024 Science Curricula about Environmental Topics Based on Bloom's Taxonomy

2018 ve 2024 Fen Bilimleri Dersi Öğretim Programlarının Çevre Konuları Bağlamında BLOOM Taksonomisine Göre Karşılaştırmalı İncelenmesi[1]

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Abstract

Purpose: The aim of this study is to comparatively examine the science curricula of 2018 science course and The Century of Türkiye Education Model's science course according to Bloom's taxonomy in the context of environmental issues.

Design/Methodology/Approach: In the study, the document analysis method, which is one of the qualitative research data collection methods, was used. In the process of selecting the Science curricula published in 2018 and 2024 to be compared in the study, the Science Curricula approved by the Board of Education was taken as the data source. The data were analysed using the content analysis method.

Findings: There were a total of 30 learning outcomes in the context of environmental issues in the 2018 science curriculum and a total of 61 learning outcomes in the 2024 science curriculum. In the 2024 science curriculum, it was noteworthy that the number of learning outcomes increased and learning outcomes were also included in the recall and evaluation stages. It is very important that the objectives in the "environment" subjects, especially in the application, analysis and evaluation stages, are more than the 2018 curriculum in order for individuals to transform their knowledge into behavior.

Öz

Çalışmanın amacı: Bu araştırmanın amacı 2018 yılı fen bilimleri dersi ve 2024 yılı Türkiye yüzyılı maarif modeli fen bilimleri dersi öğretim programlarının çevre konuları bağlamında Bloom taksonomisine göre karşılaştırmalı olarak incelenmesidir.

Materyal ve Yöntem: Araştırmada, nitel araştırma veri toplama yöntemlerinden biri olan doküman inceleme yöntemine başvurulmuştur. Veriler içerik analizi yöntemi kullanılarak analiz edilmiştir. 2018 ve 2024 yıllarında yayımlanan Fen Bilimleri dersi öğretim programları karşılaştırılarak değerlendirilmiştir.

Bulgular: 2018 yılı fen bilimleri dersi öğretim programında çevre konuları bağlamında toplam 30 kazanım, 2024 yılı fen bilimleri dersi öğretim programında toplam 61 kazanım olduğu tespit edilmiştir. 2024 yılı fen bilimleri dersi öğretim programında kazanım sayısının arttığı ve hatırlama ile değerlendirme basamaklarında da kazanımlara yer verildiği dikkat çelmiştir. "Çevre" konularında özellikle uygulama, analiz etme ve değerlendirme basamaklarındaki kazanımların 2018 yılı programına göre daha fazla olması bireylerdeki bilgilerin davranışa dönüşebilmesi için oldukça önemlidir.

INTRODUCTION

Science education plays an important role in developing students' knowledge and skills about environmental issues. Curricula are the main tools that determine the scope and depth of the knowledge and skills that students should acquire in this process. In this context, science curricula have a critical importance in terms of how they address environmental issues and which cognitive objectives they focus on. The science curriculum is constantly updated in accordance with the needs of the age. While the curriculum creates a tendency towards scientific thinking in students, it also brings qualities such as gaining environmental awareness and using various disciplines together.

The 2024 Century of Türkiye Education Model is based on a holistic approach and aims to develop students in all aspects. It supports the multifaceted development of students in the context of frameworks such as skills framework, system literacy, and virtue-value-action model. The model aims to address the mental, emotional, physical, social and spiritual development of the student in a holistic manner by putting the human at the centre of education. In this model, one of the basic principles is to enable students to discover themselves and reveal their potential. For this purpose, flexible and free learning environments are created by considering the interests, needs and abilities of each student. With a student-centred and rights-based approach, an educational approach that encourages individuals to actively participate in learning processes is targeted. The Century of Türkiye Education Model has been shaped in line with the basic principles and objectives of the National Education Basic Law No. 1739. Curricula are structured in a complementary manner at preschool, primary and secondary education levels, and enable students to acquire basic level skills and competencies and prepare them for a profession, higher education and life in line with their interests and abilities (MoNE, 2024a).

The human-centred education approach, which is the basic philosophy of The Century of Türkiye Education Model, is also brought to the forefront in the Science Curriculum. This curriculum aims to raise well-equipped individuals of the future by focusing on individual responsibility, social-emotional development and the skills required by the age. The focus of the curriculum is to encourage students to become career-conscious in the field of science by developing their high-level thinking ability, scientific process skills, and ethical values. In this direction, the program aims to raise students as individuals who question, think critically, are sensitive to the environment, and exhibit scientific attitudes by encouraging them to active participation, cooperation, group work, and self-regulation. Raising individuals who are aware of the importance of digital transformation and who can adapt to changing technology are also among the main objectives of the program. Considering the range of skills determined by the Turkish Qualifications Framework, the program adopts a science teaching approach that includes 21st-century skills. While aiming for students to understand the nature of science, to comprehend the basic characteristics of scientists and to question the reliability of information sources, an interdisciplinary and transdisciplinary science teaching is planned. At the same time, it aims to raise individuals who are aware of sustainability and use resources efficiently in line with this awareness, who are sensitive to nature, who can create solutions to local and global environmental problems, and who will act with a sense of social responsibility and contribute to the development of the country (MoNE, 2024b).

Science teaching based on sustainability is essential in raising conscious individuals for today's environmental problems and the solution to these problems. Environmental education plays an important role in ensuring environmental awareness, adopting a sustainable lifestyle and approaching environmental problems critically. Environmental education aims to transfer ecological knowledge to students, to develop an attitude towards the environment and to transform this attitude into behavior and environmental awareness (Erten, 2004). Environmental education, which has its origins in the 1960s, has been included in formal education in Türkiye since 1991 (Erol & Gezer, 2006). At the primary level, there are environmental subjects in life science, science and social studies courses (Alım, 2006).

Since 1968, when the curricula were analysed, environmental issues have become increasingly important. When the 1968 Science and Natural Sciences program is examined, it is seen that one of the aims of the curriculum is to enable students to adapt to the environment in which they live and to recognise the environment. In the 1992 Science and Natural Sciences program, the aims of the curriculum include the student's recognition, protection and love of the environment and perceiving the effects of human beings on the environment. In the 2000 Science and Technology curriculum, emphasis was again placed on knowing, loving and protecting the environment and being able to perceive the effects of humans on the environment (Dindar & Taneri, 2011). The aims of the 2005 Science and Technology program were to recognize environmental problems and understand their interactions with the environment (MoNE, 2005) (MoNE, 2005). The 2013 Science and Technology program aims to develop sustainable development awareness, gain knowledge about environmental science, and understand the relationship between humans and the environment (MoNE, 2013). When the 2018 science program was examined, the aims included gaining basic knowledge about environmental sciences, understanding the interaction between humans and the environment, and developing sustainable development awareness (MoNE, 2018).

The objectives and outcomes related to environmental issues in science curricula emphasise the importance of environmental education and aim to provide students with environmental awareness and sustainability consciousness. In this context, Bloom's

Taxonomy can be used to analyse environmental education objectives in a more systematic and structured way. This taxonomy is an effective tool for identifying and progressively analyzing objectives. It is classified into three basic areas: cognitive, affective, and kinaesthetic, and proceeds in a hierarchical order (Bloom, 1956). The cognitive domain, which is the main domain in which the learning outcomes in the curriculum are frequently found, is categorised as knowledge, comprehension, application, analysis, synthesis, and evaluation. The explanation of the cognitive domain stages of Bloom's taxonomy is as follows (Bloom, 1956):

1. Knowledge: Remembering and recognising previously learned information.

2. Comprehension: Not only remembering information, but also interpreting and making sense of it.

3. Application: The ability to use knowledge in different contexts.

4. Analysing: Separating information into its components and establishing a relationship between them.

5. Synthesis: Reorganisation and originalisation of information.

6. Evaluation: Assessing a situation according to a specific purpose and criterion.

While knowledge, comprehension, and application stages are defined as lower-level stages, analysis, synthesis and evaluation stages are defined as higher-level stages. Bloom's Taxonomy is one-dimensional and progresses cumulatively (Bloom, 1956). Bloom's taxonomy was revised by Anderson and Krathwohl (2001). The terminology of Bloom's taxonomy has also been revised. There are two different dimensions in the revised taxonomy. These are knowledge and scientific process. The knowledge dimension includes factual, conceptual, procedural, and metacognitive knowledge dimensions. The stages of the cognitive domain of the taxonomy are remembering, understanding, applying, analysing, evaluating and creating (Anderson & Krathwohl, 2001).

The cognitive domains of the new taxonomy are as follows (Anderson & Krathwohl, 2001, p. 39):

1. Knowledge; remembering and recalling information about the subject through long-term memory.

2. Comprehension; commenting, giving examples, classifying, summarising, making inferences, making explanations and formatting the information presented in words, writing or figures.

3. Application; being able to use or reveal operations by making and applying.

4. Analysing; analysing the data by breaking them down, determining the relationships of all parts with each other and the whole they form.

5. Synthesis; examining the data in general terms within the framework of certain criteria and making judgements based on the criteria.

6. Evaluation; forming a functional and harmonious structure by combining elements; creating a new system or structure through the processes of planning, producing and creating.

In the revised Bloom's Taxonomy, the cognitive domain becomes more dynamic. The "synthesis" stage was renamed as "creation" and became the highest stage of the cognitive domain. Thanks to this taxonomy, teaching strategies that focus on higher level thinking skills are focused. Students' critical thinking and problem-solving skills are strengthened, and the learning process becomes more meaningful (Krathwohl, 2002). In multidisciplinary fields, it enables not only the recognition of the factors related to the relevant subject but also the evaluation of the factors (Forehand, 2010).

Examining the curricula within the framework of the structural model provided by the Revised Bloom's taxonomy enables the enrichment and evaluation of the content of education and training both theoretically and practically. The revised Bloom's Taxonomy has two dimensions. In the horizontal dimension, knowledge, comprehension and synthesis stages in the old taxonomy were renamed and synthesis and evaluation stages were replaced. Conceptual, procedural, and factual knowledge types are included in the vertical dimension, and metacognitive knowledge types are added (Bümen, 2006).

A comparative analysis of the 2018 Science Curriculum and The 2024 Century of Türkiye Education Model Science Curriculum in the context of environmental issues can provide an understanding of which cognitive objectives are prioritised within the framework of Bloom's Taxonomy. In this direction, the capacity of the curricula to create environmental sensitivity and awareness can be evaluated and the effect of the curricula on raising sustainability awareness can be analysed. In addition, a comparative analysis of curricula can provide a perspective on how a transformation and change have taken place in environmental education and contribute to the guidance of future educational policies by taking into account today's changing world conditions.

Purpose of the Study

The aim of this study is to comparatively examine the science curricula of 2018 science course and the 2024 Century of Türkiye Education Model science course curricula according to Bloom's taxonomy in the context of environmental issues. In line with the main purpose of the research, answers to the following questions were sought:

1. How is the 2018 science curriculum distributed regarding the cognitive domains of Bloom's taxonomy in the context of environmental issues?

2. How is the distribution of the 2024 Century of Türkiye Education Model science curriculum in terms of the cognitive domains of Bloom's taxonomy in the context of environmental issues?

3. What is the comparative distribution of 2018 and 2024 science curricula in terms of cognitive domains of Bloom's taxonomy in the context of environmental issues?

METHOD/MATERIALS

In this section, information about the research model, data collection process, data analysis and validity and reliability of the study are presented.

Research Model

This study employs the document analysis method, which is a qualitative research data collection method. The document analysis method enables the researcher to access the data directly through documents without observation or interviews (Yıldırım & Şimşek, 2008). The stages followed within the scope of this method are as follows:

1. Documents suitable for the purpose of the research were obtained through the Presidency of the Board of Education.
2. Each curriculum was examined in detail and its originality was evaluated.
3. After the review, quotations were made from the necessary sections.
4. The collected data were analysed by content analysis method and evaluation procedures were carried out.
5. As a result, data were used (Çepni, 2018; Yıldırım & Şimşek, 2008).

Data Collection Tools

In document analysis, it is important that the documents used as data collection tools provide reliable and accurate information. Therefore, it is critical to refer to primary sources as much as possible (Creswell & Clark, 2017). Accordingly, in the research process, science curricula were used as primary data sources by collecting and examining written and visual materials. In the study, a comparison was made between the 2018 and 2024 Science curricula according to the revised Bloom's taxonomy. The selection of these programs was based on the Science Curricula approved by the Board of Education.

Figure 1. 2018 and 2024 Science Curricula

Analysing the Data

Data analysis was performed using the content analysis method. Content analysis involves creating certain codes and themes by looking for similarities in the data. These themes are then organised and interpreted in a meaningful way (Creswell, 2012). The content analysis process includes the following stages:

1. Identification of codes,

2. Creating themes by grouping similar codes,

3. Organisation of codes and themes,

4. Validity and reliability studies and calculation of frequencies,

5. Describing and interpreting findings (Denzin & Lincoln, 2005).

In this study, the cognition dimension of Bloom's taxonomy, which was renewed on the basis of "environment" topics in the content analysis process, was determined as the analysis criterion. The findings of the content analysis in the programs are presented in the form of tables. The researchers examined each program separately and created detailed tables according to Bloom's taxonomy cognition stages on the basis of "environment" topics. Inter-rater reliability calculation was performed for each stage, using the reliability = consensus / (consensus + disagreement) formula (Miles & Huberman, 1994). The reliability coefficient for the themes created by the two researchers was .89. The coders reached a consensus. Since this result shows that the reliability of the cognition stages of the revised Bloom's taxonomy is greater than .70, it is accepted to have high reliability (Yıldırım & Şimşek, 2008).

Validity and Reliability of the Study

The validity and reliability of this study were evaluated in detail. When evaluating validity, it is important to comprehensively address all aspects of the subject under investigation and to ensure data diversity (Yıldırım & Şimşek, 2018). In this study, primary data sources were accessed. The fact that the documents provide reliable and accurate information, and that they refer to primary sources as much as possible and verify the necessary points with the support of field experts played an important role in ensuring validity. In addition, the researchers presented the findings in detail. It is thought that the research findings can be generalised to similar studies and situations.

In order to ensure the reliability of the research, the researchers analysed the data separately and tried to minimise the differences in coding and categories. The researchers' being educators and their experience in curriculum development made a significant contribution to the conduct of the process, data collection and evaluation. It is thought that the diversity of the study group can provide an idea about the course of the research for those who will conduct similar research. The details of the research process and accessing the primary sources correctly by the researchers elaborated the data analysis process.

FINDINGS

In this section, the findings obtained in this research are presented respectively within the framework of the research questions. In this study, the extent to which the renewed Bloom's taxonomy cognition dimension of the "environment" subject was included in the 2018 and 2024 science (Grades 3-8) curricula.

1. Findings and Comments Related to the 2018 Science Curriculum

How is the 2018 science curriculum distributed regarding the cognitive domains of Bloom's taxonomy in the context of environmental issues? The results of the content analysis obtained for the sub-problem are given in Table 1.

Table 1. Findings on the Classification of the 2018 Science Curriculum "Environmental" Topics According to the Cognitive Domains of the Revised Bloom's Taxonomy

2018 Science Curriculum	Remember		Understand		Apply		Analyse		Evaluate		Create	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Grade 3	-	0	3	10	2	6,66	-	-	-	0	1	3,33
Grade 4	-	0	1	3,33	1	3,33	-	-	-	0	-	-
Grade 5	-	0	3	10	3	10	2	6,66	-	0	-	-
Grade 6	-	0	-	-	-	-	1	3,33	-	0	-	-
Grade 7	-	0	2	6,66	2	6,66	-	-	-	0	1	3,33
Grade 8	-	0	3	10	2	6,66	3	10	-	0	-	-
Total	-	0	12	40	10	33,3	6	20	-	0	2	6,66

When Table 1 was examined, it was determined that there were 30 objectives in the context of environmental issues in the 2018 science curriculum. It was seen that 40% of these outcomes were at the comprehension stage, 33.3% at the application stage, 20% at the analysis stage and 6.6% at the creation stage.

The classification of the 2018 Science Curriculum "Environment" subject according to the cognitive domain of the renewed Bloom's taxonomy is given in Table 2.

Table 2. 2018 Science Curriculum "Environment" Topic Renewed Bloom Findings Related to the Classification of the Cognitive Domain of the Taxonomy According to the Acquisitions

2018 Science Curriculum	Remember	Understand	Apply	Analyse	Evaluate	Create
Grade 3	-	F.3.6.2.1. F.3.6.2.3 F.3.6.2.5.	F.3.6.2.2. F.3.6.2.6.	-	-	F.3.6.2.4.
Grade 4	-	F.4.6.1.2.	F.4.6.1.1.	-		-
Grade 5	-	F.5.6.1.1. F.5.6.2.1. F.5.6.3.1.	F.5.6.2.2. F.5.6.2.3. F.5.6.3.2.	F.5.6.1.2. F.5.6.2.4.	-	-
Grade 6	-			F.6.4.4.2.	-	-
Grade 7	-	F.7.4.5.1. F.7.4.5.3.	F.7.4.5.2. F.7.4.5.4.	-	-	F.7.4.5.5.
Grade 8	-	F.8.6.3.1. F.8.6.3.2. F.8.6.4.3.	F.8.6.4.1. F.8.6.4.2.	F.8.6.3.3. F.8.6.4.4. F.8.6.4.5.	-	-
Total	-	12	10	6	-	2

When Table 2 is examined, it is seen that the 30 objectives in the context of environmental issues in the 2018 science curriculum are numbered in detail. There are no learning outcomes in the recall and evaluation stage. The 2018 Science curriculum distribution of the objectives according to the cognitive domain according to the grades is given in Figure 2.
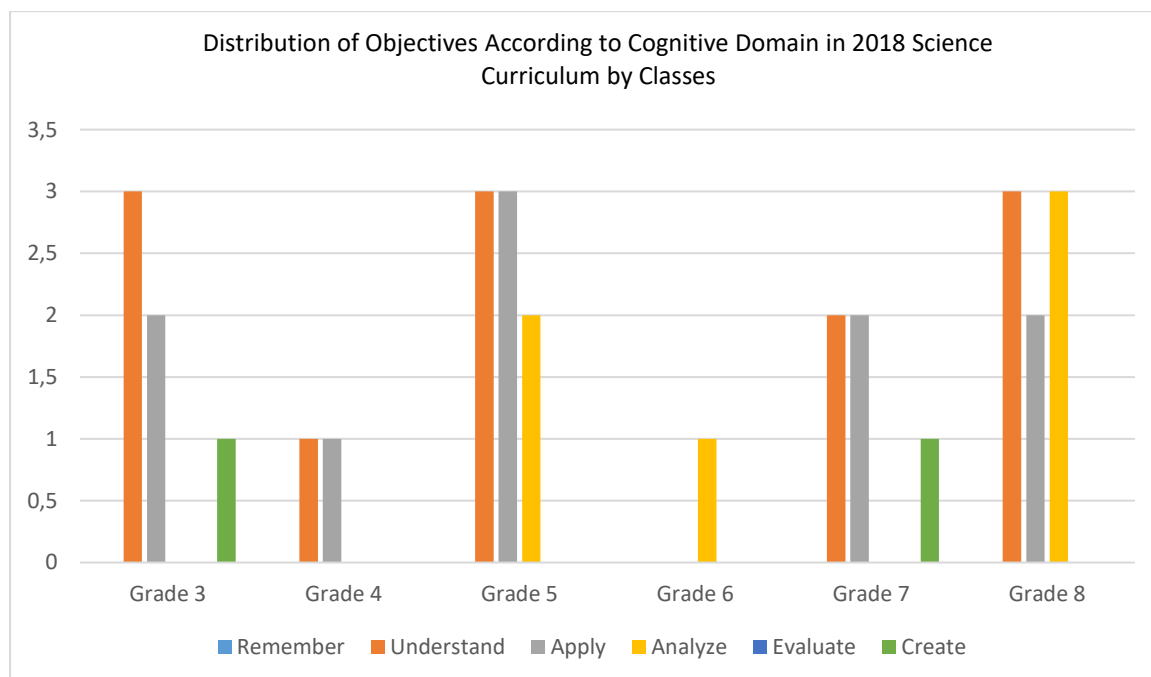
Figure 2. 2018 Science Curriculum Distribution of Outcomes According to Cognitive Domain by Grade

When Figure 2 is analysed, it is seen that there are no objectives at every stage in the cognitive domain at each grade level. In the 2018 Science curriculum, it is noteworthy that there is no objective in the evaluation stage.

2. Findings and Comments Related to the 2024 Science Curriculum

How is the distribution of the 2024 Century of Türkiye Education Model science curriculum in terms of the cognitive domains of the renewed Bloom's taxonomy in the context of environmental issues? The results of the content analysis obtained for the sub-problem are given in Table 3.

Table 3. Findings Related to the Classification of the "Environment" Topic of the 2024 Science Curriculum according to the Cognitive Domain of the Revised Bloom's Taxonomy

2024 Science Curriculum	Remember		Understand		Apply		Analyse		Evaluate		Create	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Grade 3	1	1,64	3	4,92	3	4,92	-	-	-	-	-	-
Grade 4	-	-	1	1,64	2	3,28	1	1,64	2	3,28	-	-
Grade 5	1	1,64	2	3,28	5	8,20	1	1,64	1	1,64	-	-
Grade 6	1	1,64	4	6,56	1	1,64	5	8,20	6	9,84	-	-
Grade 7	-	-	2	3,28	2	3,28	2	3,28	2	3,28	-	-
Grade 8	1	1,64	4	6,56	-	-	3	4,92	5	8,20	-	-
Total	4	6,56	16	26,24	13	21,32	12	19,68	16	26,24	-	0

When Table 3 was examined, it was determined that there were 61 learning outcomes in the context of environmental issues in the 2024 science curriculum. It was determined that 6,56% of these outcomes were in the recall, 26,24% in the comprehension, 21,32% in the application, 19,68% in the analysis, and 26,24% in the evaluation stage. There is no acquisition related to the creation stage. 2024 Science Curriculum "Environment" subject of the renewed Bloom's taxonomy cognitive domain of the renewed Bloom's taxonomy classification according to the objectives is given in Table 4.

Table 4. Findings Related to the Classification of the 2024 Science Curriculum "Environment" Subject According to the Gains in the Cognitive Domain of the Revised Bloom's Taxonomy

2024 Science Curriculum	Remember	Understand	Apply	Analyse	Evaluate	Create
Grade 3	FB.3.7.1.a	FB.3.7.1.c FB.3.7.2.b FB.3.7.2.c	FB.3.7.1.b FB.3.7.2.a FB.3.7.2.ç	-	-	-
Grade 4	-	FB.4.8.1.a	FB.4.8.1.b FB.4.8.1.c	FB.4.8.1.ç	FB.4.8.1.d FB.4.8.1.e	-
Grade 5	FB.5.7.1.1.a	FB.5.7.1.2.a FB.5.7.1.3.a	FB.5.7.1.1.b FB.5.7.1.1.c FB.5.7.1.1.ç FB.5.7.1.2.b FB.5.7.1.2.c	FB.5.7.1.3.b	FB.5.7.1.3.c	-
Grade 6	FB.6.7.1.1.a	FB.6.7.1.1.b FB.6.7.1.2.a FB.6.7.2.2.a FB.6.7.2.2.b	FB.6.7.1.1.c	FB.6.7.1.1.d FB.6.7.1.2.b FB.6.7.1.2.ç FB.6.7.2.1.b FB.6.7.2.2.ç	FB.6.7.1.1.ç FB.6.7.1.2.c FB.6.7.2.1.a FB.6.7.2.1.c FB.6.7.2.2.c FB.6.7.2.2.d	-
Grade 7	-	FB.7.7.1.1.b FB.7.7.2.1.a	FB.7.7.2.1.b FB.7.7.2.1.c	FB.7.7.1.1.a FB.7.7.2.1.ç	FB.7.7.2.1.d FB.7.7.2.1.e	--
Grade 8	FB.8.7.2.1.a	FB.8.7.2.1.b FB.8.7.2.2.b FB.8.7.2.4.a FB.8.7.2.4.b	-	FB.8.7.2.2.a FB.8.7.2.3.b FB.8.7.2.4.ç	FB.8.7.2.1.c FB.8.7.2.3.a FB.8.7.2.3.c FB.8.7.2.4.c FB.8.7.2.4.d	-
Total	4	16	13	12	16	0

When Table 4 is examined, a detailed acquisition numbering of the 61 acquisitions in the context of environmental issues in the 2024 science curriculum is seen. There is no learning outcome in the creation stage. The distribution of 2024 Science Curriculum according to the cognitive domain of the objectives according to the grades is given in Figure 3.
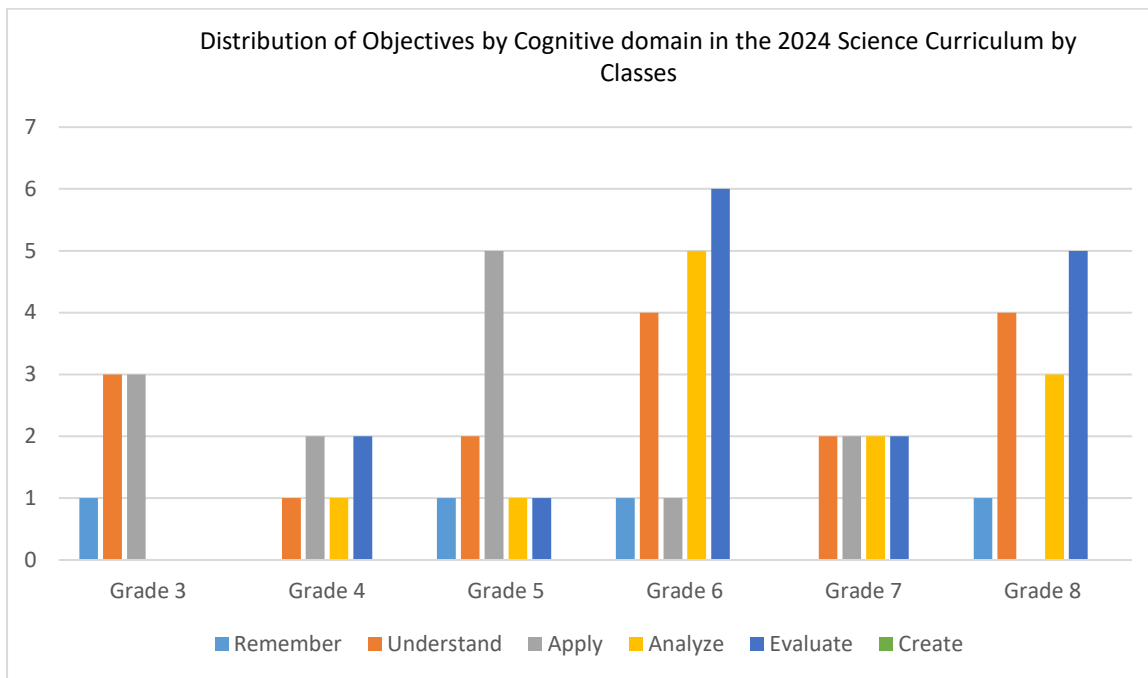
Figure 3. 2024 Science Curriculum Distribution of Outcomes According to Cognitive Domain by Grade

When Figure 3 is analysed, it is seen that there are no objectives at every stage in the cognitive domain at each grade level. In the 2024 Science curriculum, it is noteworthy that there is no outcome in the create stage. It is seen that the outcomes are mostly in the comprehension and evaluation stages.

3. Findings and Comments on 2018 and 2024 Science Curriculum

How do the 2018 and 2024 science curricula compare in terms of the cognitive domain of the revised Bloom's taxonomy in the context of environmental issues? The results of the content analysis obtained for the sub-problem are given in Table 5.

Table 5. Findings Related to the Comparison of 2018 and 2024 Science Curriculum "Environment" Subject According to the Cognitive Domain of the Revised Bloom's Taxonomy

Grade Level	Remember		Understand		Apply		Analyse		Evaluate		Create		Total	
	2018	*2024*	*2018*	*2024*	*2018*	*2024*	*2018*	*2024*	*2018*	*2024*	*2018*	*2024*	*2018*	*2024*
Grade 3	0	1	3	3	2	3	-	-	0	-	1	-	6	7
Grade 4	0	-	1	1	1	2	-	1	0	2	-	-	2	6
Grade 5	0	1	3	2	3	5	2	1	0	1	-	-	8	10
Grade 6	0	1	-	4	-	1	1	5	0	6	-	-	1	18
Grade 7	0	-	2	2	2	2	-	2	0	2	1	-	5	6
Grade 8	0	1	3	4	2	-	3	3	0	5	-	-	8	13
Total	**0**	**4**	**12**	**16**	**10**	**13**	**6**	**12**	**0**	**16**	**2**	**-**	**30**	**61**

When Table 5 is examined, it is seen that the environmental learning outcomes in the 2024 science curriculum are more numerous and at higher levels than the 2018 science curriculum. The distribution of 2018 and 2024 Science curricula outcomes according to the cognitive domain is given in Figure 4.

Figure 4. 2018 and 2024 Science Curricula Distribution of Outcomes According to Cognitive Domain

When Figure 4 is examined, it is seen that the learning outcomes in the context of environmental issues are included in the 2018 curriculum with fewer outcomes and in 4 stages (understanding, applying, analysing, creating), while they are included in 5 stages (remembering, understanding, applying, analysing, evaluating) in the 2024 curriculum.

DISCUSSION AND CONCLUSION

In this study, the distribution of the 2018 science curricula and the 2024 Century of Türkiye Education Model science curricula in terms of cognitive process dimensions according to the revised Bloom's taxonomy in the context of environmental issues was examined comparatively.

Discussion and results are organised according to the sub-problems of the research and explained below.

Discussion and Conclusion on the Distributions of the Cognitive Process Dimensions of the Revised Bloom's Taxonomy in the Context of Environmental Subjects of the 2018 Science Curriculum

According to the findings obtained from the study, the distribution of the cognitive domain of the revised Bloom's taxonomy in the context of environmental issues in the 2018 science curriculum was not equal. In the 2018 science curriculum, it was determined that 30 objectives were included in the context of environmental issues. It is seen that 12 of them are in the comprehension stage, 10 in the application stage, 6 in the analysing stage and 2 in the creating stage. It was determined that most objectives were in the comprehension stage. In terms of percentage, 40% of these objectives were found to be in the comprehension stage, 33,3% in the application stage, 20% in the analysis stage and 6,6% in the create stage.

It is noteworthy that the acquisitions involving higher-level thinking skills are quite low. In the curriculum, especially in the "Environment" subjects, it is essential to have more acquisitions at the application and higher levels for individuals to transform their knowledge into behavior. Considering the studies in the literature, it is understood that similar results are obtained. Güngör Cabbar et al. (2020), in their study in which they analysed the environmental acquisitions encountered by students in science and biology courses in 2018 according to the revised Bloom's taxonomy, revealed that the acquisitions were not homogeneously distributed and there were almost no acquisitions in the application stage.

In their study, Erten, Köseoğlu, and Gök (2022) revealed the similarities and differences in the objectives for environmental education at the 5th, 6th, 7th and 8th-grades in the science curricula of Türkiye (2018), Canada (2007) and the State of Nebraska in the United States of America (2011). In Türkiye's 2018 science curriculum, it was determined that the presence of objectives related to environmental education at each grade level was similar to Canada. However, it is also seen that the acquisitions in these subject areas are not in integrity with other acquisitions. According to the results of this research, Turkish Science Curriculum can be considered neither as adequate as Canadian Science Curriculum nor as inadequate as Nebraska. In this context, it is suggested that the Turkish Science Curriculum should be further developed in terms of environmental education.

These results of the study are similar to the results of the studies conducted by Tanrıverdi (2009), Cebesoy and Dönmez-Şahin (2010) in which the environmental issues of the 2005 Science curriculum were examined.

2024 Türkiye's Century of Education Model Discussion and Conclusion on the Distribution of the Cognitive Process Dimensions of the Revised Bloom's Taxonomy in the Context of Environmental Issues in the Science Curriculum

According to the findings obtained from the research, the distribution of the cognitive domain of the renewed Bloom's taxonomy in the context of environmental issues in the 2024 science curriculum was not homogeneous. In the 2024 science curriculum, it was determined that 61 learning outcomes were included in the context of environmental issues. Of these, it is seen that 4 learning outcomes are in the remembering, 16 learning outcomes are in the understanding, 13 learning outcomes are in the application, 12 learning outcomes are in the analysing, and 16 learning outcomes are in the creating stage. It was determined that the most learning outcomes were in the comprehension stage and the least in the creation stage. In the 2024 science curriculum, it was determined that 61 learning outcomes were included in the context of environmental issues. In terms of percentage, it was determined that 6.56% of these outcomes were in the recall, 26.24% in the comprehension, 21.32% in the application, 19.68% in the analysis, and 26.24% in the evaluation stage. There is no acquisition related to the creation stage. It is noteworthy that there are very few acquisitions involving high-level thinking skills and no acquisitions are included in the creation stage. In the curriculum, especially in the "Environment" subjects, it is essential to have more acquisitions at the application and higher stages for individuals to transform their knowledge into behavior.

When the studies in the literature are considered, it is understood that similar results are obtained. Gökdere (2005) found that secondary school students could not sufficiently understand some topics related to the environment and suggested that to solve this problem, education programs should be enriched with topics such as natural environment, energy resources, and environmental pollution, and students should be provided with various materials from their own environment. The lack of some topics and concepts may make it difficult for students to understand the environment comprehensively. Therefore, scientific data and research should be taken more into consideration in the development and updating of programs.

The 2024 Science Curriculum adopts a student-centred holistic education approach. This approach considers learning as a process that aims to develop students' scientific thinking and decision-making abilities. In this process, development areas complement each other to form a whole and each area affects the others, thus ensuring continuous and cumulative progress. One of these areas is "Sustainability-Based Science Teaching". Sustainability-based science teaching includes topics that aim to make students think about sustainability and gain life skills related to this concept. This approach aims to raise individuals who can use resources effectively, are sensitive to nature, have awareness of local and global environmental problems, can develop solutions and have cognitive awareness. In the science teaching process, individuals are encouraged to develop a sense of social responsibility and contribute to the development of the country by emphasising sustainability awareness. In addition, it is aimed to increase the entrepreneurship and productivity skills of individuals with the knowledge and experiences gained based on sustainability (MoNE, 2024a). The 2024 Science Curriculum aims to enable students to use natural resources effectively with sustainability awareness, to develop awareness on global citizenship and environmental ethics, and to act sensitively towards nature and environmental problems.

One of the primary objectives of the 2024 Century of Türkiye Education Model is to provide students with literacy skills. One of these skills is sustainability literacy, which constitutes system literacy. According to the integration of system thinking in the common text, sustainability literacy is based on awareness, functionality and action. Based on awareness, understanding sustainability and sustainable development involves understanding sustainable and non-sustainable systems. Based on functionality, it includes analysing the components of sustainability and sustainable development, structuring sustainable and non-sustainable systems, discussing problems and issues related to non-sustainable systems. Based on the action, it includes creating/selecting/using tools that predict sustainable system behaviours, solving problems affecting the sustainability of systems, and transforming the solution proposals developed for the sustainability of systems into action. Sustainability literacy includes 8 integrated skills and 25 process skills (MoNE, 2024b). Science courses should integrate these literacy skills and present them to students.

In the 2024 Science Curriculum, the following planning was made by considering the subject content, specific days and weeks and learning environments while sequencing the units. In the 2024 Science Curriculum, the last units in the context of environmental issues are divided into "Sustainability" themes (MoNE, 2024a):

Grade 3 Unit 7: I Know the Soil, I Discover Agriculture and Grade 3 Unit 8: Journey to the Habitats of Living Things

Grade 4 Unit 8: Sustainable Cities and Communities

Grade 5 Unit 7: Sustainable Living and Recycling

Grade 6 Unit 7: Sustainable Living and Interaction

Grade 7 Unit 7: Sustainable Living and Energy

Grade 8 Unit 7: Sustainable Living and Material Cycles

In this context, to benefit from out-of-school learning environments, the last units, which coincided with the spring months, were organised to focus on sustainability and environmental issues. Within the framework of environmental issues, it is thought that providing appropriate time and environmental conditions will be effective in the acquisition of cognitive skills at the application stage.

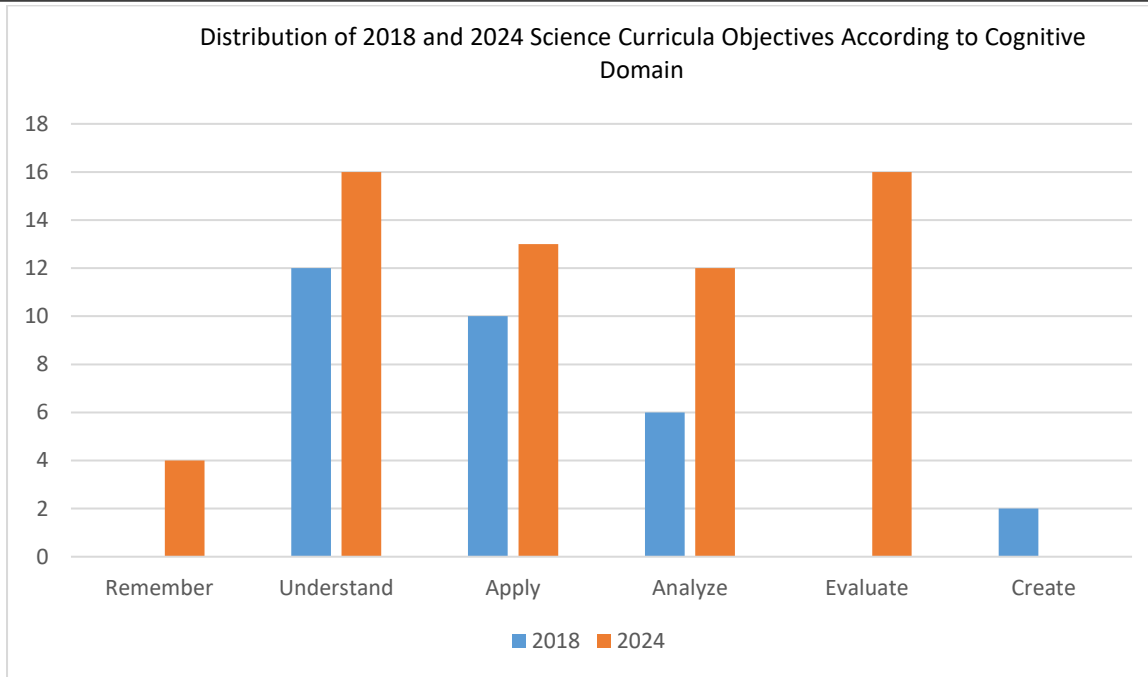**Discussion and Conclusion on the Distribution of 2018 and 2024 Science Curriculum in terms of Cognitive Domain of the Revised Bloom's Taxonomy in the Context of Environmental Issues**

According to the findings obtained from the study; it was seen that the distributions of the cognitive domain of the revised Bloom's taxonomy in the context of environmental issues in the science curricula of 2018 and 2024 were not homogeneously distributed. In the 2018 science curriculum, it was determined that there were a total of 30 objectives in the context of environmental issues and a total of 61 learning outcomes in the 2024 science curriculum. In the 2024 science curriculum, it was noteworthy that the number of learning outcomes increased and learning outcomes were also included in the recall and evaluation stages. It is crucial that the objectives in the "environment" subjects, especially in the application, analysis and evaluation stages, are more than the 2018 curriculum for individuals to transform their knowledge into behavior. In the 2018 program, there are no acquisitions in the context of environmental issues in the recall and evaluation stage, while it is an expected and desired result that the 2024 program includes acquisitions at this stage.

In the studies conducted to compare the environmental topics in the previous science curricula, the importance of including the acquisitions at the application and higher levels for environmental topics draws attention. In their study, Özata Yücel and Özkan (2013) compared the 2013 Science Curriculum with the 2005 Science and Technology Curriculum in terms of environmental topics. In the 2005 Science and Technology program, the time allocated to environmental topics was 15.56% (112 lesson hours) of the time allocated to all topics, while this rate was reduced to 14.89% (104 lesson hours) in the 2013 program. In the 2013 program, the gains related to the economical use of resources and recycling were increased, but it was seen that sample activities for the gains and suggested evaluation activities were removed.

Many studies reveal that students are inadequate in terms of environmental knowledge, their attitudes are not at the expected level, and they do not exhibit environmentally friendly behaviors (Erten, 2005). Education is the process of developing desired behaviors, and the acquisition of environmentally friendly behaviors, environmental knowledge, and the formation of positive attitudes towards the environment are closely related to curricula, which is one of the basic elements of the education process.

RECOMMENDATIONS

According to the results obtained in this study, various suggestions were made to practitioners, program developers and researchers:

Recommendations for practitioners:

This study compares the 2018 science course and the 2024 Century of Türkiye Education Model science course curricula were comparatively examined in terms of cognitive domain according to the revised Bloom's taxonomy in the context of environmental issues, methods, techniques, practices and activities that will increase students' environmental literacy levels should be included more.

At all levels of education, sustainable environmental education activities that will enable students to increase their environmental literacy levels can be included in in-school and out-of-school environments.

Recommendations for program developers:

To increase individuals' sensitivity towards the environment, it can be suggested that curricula should be updated in terms of experience and metacognitive stages.

One of the characteristics of virtuous individuals expressed in the common text of the 2024 Century of Türkiye Education Model science curriculum is to be environmentally sensitive individuals. An important stage to achieve this goal is to make environmental literacy an indispensable part of our lives.

In the 2024 Science Curriculum, 6 class hours are devoted to school-based planning that includes out-of-school learning activities. In this context, out-of-school learning environments can be planned for the environment.

Suggestions for researchers:

Environmental awareness of individuals can be analysed in terms of different socio-demographic variables. The effects of these variables on environmental awareness and the extent of this effect can be investigated.

Experimental studies can be conducted to support and monitor the development of environmental awareness on individuals.

Environmental awareness levels of students at primary, secondary, high school, and higher education levels can be examined, and comparisons can be made between these levels.

Environmentally friendly learning activities or modules that can be included in curricula can be developed.

Declaration of Conflicting Interests

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Statements of publication ethics

As this study is based on research and document analysis, it does not fall within the scope of studies requiring 'Ethics Committee Approval.' Therefore, Ethics Committee Approval has not been declared in this context.

Examples of author contribution statements

Concept – E.B.Ö.; Design – E.B.Ö.; Supervision – E.B.Ö., M.S.; References –E.Y.; Data Collection and/or Processing – E.B.Ö., E.Y., M.S.; Analysis and/or Interpretation – E.Y., M.S.; Literature Review – E.Y., E.B.Ö.; Writing – E.B.Ö., E.Y., M.S.; Critical Review – M.S., E.B.Ö., E.Y.

Researchers' contribution rate

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

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| Research Article / Araştırma Makalesi|

Comparison of Classification Accuracy and Parameters of DINA, DINO, HO-DINA and HO-DINO Models in the Framework of Cognitive Diagnosis in Health Education

Sağlık Eğitiminde Bilişsel Tanı Çerçevesinde DINA, DINO, HO-DINA ve HO-DINO Modellerinin Sınıflama Doğruluğu ve Parametrelerinin Karşılaştırılması[1]

Sena Gencan[2], Şeref Tan[3]

Abstract

Purpose: This study aims to compare the parameters of DINA, DINO, HO-DINA and HO-DINO models according to different sample sizes (500, 2000, 5000) and different item numbers (60, 120) based on the Q matrices created for different attributes in health education based on simulation data.

Design/Methodology/Approach: In the simulation data, 50 replications were performed for each condition. In the study, two different Q-Matrixes were determined based on the learning domain determined by considering the 2018 TUS Spring Assessment Report and the taxonomy included in the Clinical assessment framework determined in Miller's 1990 study as the attributes dimension in the Q-Matrix in which matching of attribute and item is carried out. In the study, RMSEA, g and s parameters and classification accuracies were compared and under which conditions DINA, DINO, HO-DINA and HO-DINO models gave similar or different results were investigated.

Findings: According to the research findings, the Q-Matrix, in which Fields levels were used as the attribute dimension, was the matrix that gave the best parameter results in all models. In addition, it has been determined that the models that give the best RMSEA, g and s parameters and classification accuracies are DINO and HO-DINO models in the analysis.

Highlights: Based on the findings, when analyzing the results for the Basic Medical Sciences and Clinical Medical Sciences tests, it is evident that the Q matrix determined by Fields provides a better fit to the data, and moreover, it is advantageous for the Q matrix determined by Fields to be used for the TUS exam.

Öz

Çalışmanın amacı: Bu çalışma simülasyon verilerine dayalı olarak sağlık eğitiminde farklı niteliklere göre oluşturulan Q matrislerini temel alarak DINA, DINO, HO-DINA ve HO-DINO modellerinin parametrelerini farklı örneklem büyüklüğü (500, 2000, 5000) ve farklı madde sayılarına (60, 120) göre karşılaştırmayı amaçlamaktadır.

Materyal ve Yöntem: Simülasyon veride her bir koşul için 50 replikasyon yapılmıştır. Çalışmada, nitelik ile madde eşleştirmesinin yapıldığı Q-Matrisinde nitelik boyutları olarak 2018 TUS İlkbahar Değerlendirme Raporu göz önüne alınarak belirlenen öğrenme alanları ve Miller'in 1990 yılındaki çalışmasında belirlediği Klinik değerlendirme çerçevesinde yer alan taksonomi temel alınarak iki farklı Q- Matrisi belirlenmiştir. Çalışmada RMSEA, g ve s parametreleri ve sınıflama doğrulukları karşılaştırılmış ve DINA, DINO, HO-DINA ve HO-DINO modellerinin hangi koşullar altında benzer ya da farklı sonuç verdikleri incelenmiştir.

Bulgular: Araştırmanın bulgularına göre nitelik boyutu olarak Alanlar düzeylerinin kullanıldığı Q-Matrisi tüm modellerde en iyi parametre sonuçları veren matris olmuştur. Ayrıca yapılan analizlerde en iyi RMSEA, g ve s parametreleri ve sınıflama doğruluklarını veren modellerin DINO ve HO-DINO modelleri olduğu tespit edilmiştir.

Önemli Vurgular: Bulgulara dayanarak Temel Tıp ve Klinik Tıp Bilimleri testi için sonuçlar incelendiğinde Alanlara göre belirlenen Q matrisinin veriye daha iyi uyum sağladığı görülmekle birlikte Alanlara göre belirlenen Q matrisinin TUS sınavı için kullanılmasının daha avantajlı olduğu ortaya konulmuştur.

INTRODUCTION

Health in the World Health Organization Charter (1948) is defined as "a state of physical, social and spiritual well-being and not merely the absence of disease or infirmity". Health, one of the basic human rights, is not the purpose of people's life, but it is a resource for people to continue their daily lives. (Sağlık Bakanlığı, 2011).

On the other hand, health services are the services provided for the elimination of various factors that harm human health and the protection of society from the effects of these factors, the treatment of patients, and the rehabilitation of those with reduced physical and mental abilities and skills (Ministry of Health, 2001). Various health institutions operating in the private and public sectors provide health services to the community through doctors, nurses and other health personnel (Bakan et al., 2011). In the study by Doğan and Gencan (2014), in which doctors, nurses and other health personnel are considered the basic inputs in producing health services, it has been exposed that doctor are the most important input in providing health services.

In order to ensure quality assurance in health services, it is an important priority to equip the labor force of doctors, nurses and other health personnel with health services (Aydın & Demir, 2006). Medical faculties fulfill the task of training doctors, who are the most important personnel in delivering health services. Medical education aims to train doctors who will support and improve the health of all people (World Health Organization, 1988). When evaluated in this context, it is seen that it is important to create test designs that will make appropriate diagnoses in measurement and evaluation processes in health education.

Diagnostic assessments provide students, their families, and educators with more detailed information about scores. Diagnostic assessments that provide students and teachers with reliable feedback on student strengths and weaknesses impact education and training significantly. (Jang & Wagner, 2014).

Diagnostic tests measure a person's competencies on components embedded in the theoretical learning model to aid instructional design. (Grégoire, 1997). Such diagnostic assessments identify specific deficiencies in students' essential prior skills or knowledge or permanent mislearning. Prior skills or knowledge include concepts or tasks required to complete the targeted tasks in the teaching field successfully and are often called ability in the cognitive model (Tatsuoka & Tatsuoka, 1997). Cognitive Diagnostic Models (CDMs) are one of the diagnostic assessment approaches that provide statistical classification of participants according to one or more abilities. (Rupp et al., 2010).

CDMs, which have gained increasing importance in the measurement literature in recent years, are essential for accurately classifying and ultimately identifying where and how respondents are missing from educational measurements to clinical assessments. (Rupp et al., 2010). In the literature, there are many studies in which CDMs are used in educational measurements. However, there are limited studies in which cognitive diagnosis models (CDM) are used in medical education (e.g. Collares, 2022).

Q matrix is used for analysis in all models of CDMs. The Q matrix defines the attributes required for a high probability of correctly answering each item. Each item in the Q matrix takes a value of 1 if the attribute is required and 0 if it is not (Henson et al., 2009). In some cases, a condition of having all the sub-skills measured by that item is required in the Q matrix, and possible attribute profiles are grouped under a particular hierarchy of skills. Thus, the attributes have a hierarchical structure (Aryadoust, 2018). Examining the skills hierarchy and applying different estimation models can improve the item fit and item parameters. Similarly, misidentifying or including an irrelevant attribute in the Q matrix can lead to classification problems in the model (DeCarlo, 2011; Su, 2013). In this respect, the correct specification of the Q matrix is one of the most critical steps in CDM analysis (Henson et al., 2009).

Due to the fact that DINA and DINO models (Templin & Bradshaw, 2014) are the most widely used CDM models in the literature, they were preferred in this study. In addition, HO-DINA and HO-DINO models were used to analyze the hierarchical structure between skills.

Based on this information, this study aims to compare the performance of different CDM models in determining the acquisition status of specific skills in medical education and to investigate the hierarchical structure between skills. For this purpose, model fit, item parameters and classification accuracies of the DINA and DINO models, the most commonly used CDM models, and the hierarchical cognitive diagnostic models HO-DINA and HO-DINO were compared based on simulation data. In addition, another aim of the study is to determine the Q-matrix that provides the best fit. In the study, Q matrices were created using the Turkish National Medical Specialty Exam (TUS) questions applied in the Spring 2018 semester and the simulation data sets produced for these Q matrices were analyzed. In this context, the general problem statement of the research is:

How do the parameters obtained from DINA, DINO, HO-DINA and HO-DINO change with sample size, number of items and Q-matrix in cognitive diagnostic models? In the context of this general problem statement, the following questions are to be answered:

1. In the Basic Medical Sciences Test, with the change of Q matrices and the number of items to 60 and 120 and the sample size to 500, 2000, and 5000, how do the
    a. RMSEA values,
    b. g and s item parameter estimates,
    c. classification accuracies for the models?
2. In the Clinical Medical Sciences Test, with the change of Q matrices and the number of items to 60 and 120 and the sample size to 500, 2000, and 5000, how do the

a. RMSEA values,

b. g and s item parameter estimates,

c. classification accuracies for the models?

DINA, DINO, HO-DINA and HO-DINO models are briefly explained in this study.

DINA Model

The DINA model developed by Haertel (1989) is one of the simplest non-compensatory models (e.g., Haertel, E. H. 1989; Henson et al., 2009). Non-compensatory models assume that a respondent's lack of a particular attribute cannot be compensated for by a positive attribute in responding to an item (Rupp & Templin, 2007, 80-81). The interaction between the investigated attributes and the item properties defines the latent response variable, also known as the ideal response. The ideal response for the DINA model is defined as follows (Tatsuoka, 1995; De La Torre & Minchen, 2014; Rupp & Templin, 2008; Junker & Sijtsma, 2001):

$$\xi_{ij} = \prod_{k=1}^{K} \alpha_{ik}^{q_{jk}})$$ Equation 1

q_{jk} is the Q matrix for attribute k of item j. The α_{ik}, referred to as knowledge states by Tatsuoka (1995), is one if examinees i mastered attribute k and zero otherwise. If examinee i is mastered in all attributes for item j, ξ_{ij}=1; otherwise, ξ_{ij}=0. To account for the probabilistic nature of the observed response, the slip (s) and guess (g) estimation parameters associated with the ideal response are defined at the item level. The slip and guess parameters are given in Equations 2 and 3:

$$s_j = P(X_{ij} = 0 | \xi_{ij} = 1)$$
$$g_j = P(X_{ij} = 1 | \xi_{ij} = 0)$$ Equations 2 and 3

The guess probability (g), referred to as a false positive, represents the probability of responding correctly to the item when the examinees lack at least one required attribute. The slip probability (s) represents the probability that the examinees respond incorrectly when all required attributes are present and is also referred to as a false negative.

The response function for an item is given as follows:

$$P(X_{ij} = 1 | \xi_{ij}) = (1 - s_j)^{\xi_{ij}} g_j^{(1 - \xi_{ij})}$$ Equation 4

The formula given in Equation 4 includes the estimated slip (s_j) and guess (g_j) parameters for each item.

DINO Model

The DINO model, which is an alternative model to the DINA model, was developed by Templin and Henson (2006). The DINO model assumes that for an examinee to have a high probability of responding positively to an item, it is sufficient to master only one attribute, in contrast to the DINA model. (Rupp et al., 2010).

Similar to DINA, DINO models the probability of a correct response as a function of the slip parameter (sj) and the guess parameter (gj). However, instead of defining ξij, they use the parameters ωij. The latent variable ωij is defined as (Henson et al., 2009):

$$\omega_{ij} = 1 - \prod_{k=1}^{K} (1 - \alpha_{ik})^{q_{jk}}$$ Equation 5

Given ωij, the probability of a correct response is defined as:

$$P(X_{ij} = 1 | \omega_{ij}) = (1 - s_j)^{\omega_{ij}} g_j^{(1 - \omega_{ij})}$$ Equation 6

In this case, if examinee i has at least one of the required attributes for item j, ωij=1, and if examinee i has none of the required attributes, ωij=0.

The Higher-Order DINA Model and The Higher-Order DINO Model

The HO-DINA and HO-DINO models involve the hierarchical structure of cognitive abilities in the prediction process and are defined for situations where attributes are ordered hierarchically. HO-DINA and HO-DINO models have the same basic characteristics as traditional DINA and DINO models. The difference is that in the HO-DINA and HO-DINO models, possible attribute profiles are adapted under a specific attribute hierarchy. The number of attribute profiles can be determined for each hierarchical model based on the attribute hierarchy. The possible attribute profiles will differ for different attribute hierarchies (Su, 2013). HO-DINA is a model suggesting that the only necessary and sufficient condition for the response to a test item is to master all the sub-skills measured by that item (Aryadoust, 2018).

METHOD/MATERIALS

Research Design

This study aims to compare the model fit, classification accuracy and parameters of widely used cognitive diagnostic models (CDMs), DINA and DINO, with hierarchical cognitive diagnostic models, HO-DINA and HO-DINO, under different conditions. In this regard, the study is descriptive research.

Data Generation

The data sets were generated using R programming according to the conditions investigated in the study. The GDINA package was used to generate the data. The simulation conditions to evaluate the model fit, item parameters and classification accuracy of the models are: a) number of items in the test, b) sample size, c) different Q-matrices.

Table 1. Factors and Conditions Considered in The Study

Factors	Conditions		
Sample Size	500	2000	5000
Number of Items	60	120	
Q-Matrices	Fields	Miller	

The data was generated with sample sizes of 500, 2000, and 5000, number of items of 60 and 120, and different Q-matrices (Fields and Miller).

The Q-Matrix identified as "Fields" was determined based on the learning domains specified in the 2018 Spring Evaluation Report of the Turkish National Medical Specialty Exam (TUS) for the Basic Medical Sciences and Clinical Medical Sciences Tests. The attributes "Anatomy, Histology and Embryology, Physiology, Medical Biochemistry, Medical Microbiology, Medical Pathology, Medical Pharmacology" were identified as the attributes to be considered for the Basic Medical Sciences Test. In contrast, the "Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology" attributes were identified for the Clinical Medical Sciences Test. The Q-matrix identified as "Miller" was determined for the Basic Medical Sciences and Clinical Medical Sciences Tests according to the taxonomy within the clinical assessment framework defined by Miller in his 1990 study. "Knows, knows how to do, knows how to show, knows what to do" were identified as the attributes to be addressed in the Basic Medical Sciences and Clinical Medical Sciences Tests according to the taxonomy established by Miller.

As a result, data sets are generated based on 12 simulation conditions consisting of 3 different sample sizes, 2 different numbers of items and 2 different Q matrices. There are 2 sub-tests as Basic Medical Sciences and Clinical Medical Sciences Tests. Accordingly, there are 24 simulation conditions, 12 for the Basic Medical Sciences Test and 12 for the Clinical Medical Sciences Test. There are 50 replications for each simulation condition.

The sample size of 1000 for the DINA model indicates that it is sufficient to provide accurate parameter estimates, and when the results are compared, the parameters show a clear improvement when the sample size is increased from 1000 to 4000. (de la Torre et al., 2010). For this reason, the sample size was determined as 500, which is below 1000 for the small sample, 2000 for the medium-sized sample, and 5000, above 4000 for the large sample.

Furthermore, a review of the literature revealed that there are studies with several replications (iteration) of 25 (De La Torre & Douglas, 2004), 50 (Ma et al., 2022), 100 (Kalkan & Başokçu, 2019; Sünbül & Kan, 2013; De La Torre, 2009; De La Torre et al., 2010) and 500 (Templin et al., 2014; Ma & Guo, 2019). Due to the long analysis time of the sets analyzed in this study, the number of replications was determined as 50.

Measurement Instrument

The tests for which Q matrices are created in the study consisted of the 2nd Term Basic Medical Sciences Test in the Turkish National Medical Specialty Exam (TUS) and the 2nd Term Clinical Medical Sciences Test in the Turkish National Medical Specialty Exam (TUS).

The exam consists of two sections: Basic Medical Sciences Tests (TTBT) and Clinical Medical Sciences Tests (KTBT). Each test consists of 120 questions, and 150 minutes are given for each section. The exam consists of 11 fields, including Physiology, Medical Biochemistry, Medical Microbiology, Medical Pathology, Medical Pharmacology, Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology and tests basic medical knowledge and the assessment of medical concepts and diseases. TTBT includes items related to Anatomy, Histology and Embryology, Physiology, Medical Biochemistry, Medical Microbiology, Medical Microbiology, Medical Pathology, Medical Pharmacology, and KTBT includes items related to Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology. Based on the candidates' answers to these two tests, the Weighted Basic Medical Sciences Score (T Score), Weighted Clinical Medical Sciences Score (K Score), and Application Score for Contracted Family Physicians for Family Physicians Specialty Training (A Score) are calculated (Board of Higher Education (YÖK), https://dokuman.osym.gov.tr/pdfdokuman/2018/GENEL/tusilkbahardegraporweb13112018.pdf).

The TUS exam conducted in in Turkiye is also applied to diagnose and place individuals who have received medical education. With this characteristic, the TUS exam can be considered a diagnostic test. In this context, it is considered that approaching the TUS exam within the framework of cognitive diagnostic models will contribute to the field of health education.

Identification of Attributes

Attributes are identified by forming two sets of attributes based on the literature, one according to the Learning Domains and the other according to Miller's taxonomy. The first Q-matrix is developed from the 2018 Spring TUS Assessment Report, which presents the learning domains, and the second is developed based on the taxonomy within the framework of clinical evaluation determined by Miller's 1990 study.

In the initial stage of attribute identification, the fields evaluated in the TTBT and KTBT in the 2018 TUS Spring Assessment Report published regarding the TUS exam were investigated. Anatomy, Histology and Embryology, Physiology, Medical Biochemistry, Medical Microbiology, Medical Pathology, Medical Pharmacology, Medical Pathology, Medical Biochemistry, Medical Microbiology, Medical Pathology, and Medical Pharmacology were identified as the attributes to be evaluated in the Basic Medical Sciences Test. In contrast, Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology were identified as the attributes to be evaluated in the Clinical Medical Sciences Test. The 2018 Spring TUS Assessment Report, which presents the learning domains are given in Table 2.

Table 2: Attributes Represented in The 2018 TUS Spring Assessment Report

Basic Medical Sciences Learning Domains	Clinical Medical Sciences Learning Domains
Anatomy	Medicine
Histology and Embryology	Pediatrics
Physiology	Surgery
Medical Biochemistry	Obstetrics and Gynecology
Medical Microbiology	
Medical Pathology	
Medical Pharmacology	

In this study, the second set of attributes is identified based on Miller's Clinical Assessment Framework.

Table 3: Four Levels in Miller's Clinical Assessment Framework

Levels	Description
Knows	Knowledge of basic knowledge and concepts
Knows How	Knowledge of normal-abnormal structure, mechanisms and functions and adaptation of known knowledge to new situations
Shows How	Demonstration of knowledge, skills and attitudes by applying them in an educational environment and under observation
Does	Practice of the profession in real-life conditions

The attributes included in the test based on Miller's Clinical assessment framework are shown in Table 4.

Table 4: Attributes Included in The Test Based on Miller's Clinical Assessment Framework

Basic Medical Sciences Learning domains	Clinical Medical Sciences Learning domains
Knows	Knows
knows how to do	knows how to do
knows how to show	knows how to show
knows what to do	knows what to do

Determination of Q-matrix

Considering the items in the test and their responses, the opinions of four experts in the field were sought as to which attribute or attributes each item was related to. The group of experts consisted of four people who graduated from the Faculty of Medicine, passed the TUS exam and were in postgraduate specialization (Research Assist. Doctor).

For both tests (the Basic Medical Sciences Test and the Clinical Medical Sciences Test) to be applied in this study, two different sets of attributes are defined and two different Q matrices, "Fields" and "Miller" were created. Q-matrices are constructed separately for tests with 60 items and 120 items. The Q-matrices for the 120-item test are created based on the exams conducted in the 2018 Spring Session of the Turkish National Medical Specialty Exam, consisting of 120 questions. Then, the attribute profiles for the Q-matrices with 120 items are extracted, and questions related to these profiles are determined. The questions related to the profiles are reduced by half, maintaining the distribution in the 120 items test to create a 60 items test.

The Q matrix for The Basic Medical Sciences Test created based on the Fields was investigated. Questions related to each attribute profile were identified and ranked. As there is no hierarchy in the Q-matrix created according to the Fields since the

attribute profiles are 2^k ve 7 attributes, $2^7=128$ attribute profiles were determined. Sixty items were formed by taking $((n-1)/2)$ number of items for those with the odd number of items, half $(n/2)$ of the items with even number of items and at least one item for each attribute.

The Q matrix for The Clinical Medical Sciences Test created based on the Fields was investigated. Questions related to each attribute profile were identified and ranked. As there is no hierarchy in the Q-matrix created based on the fields since the attribute profiles are 2^k ve 4 attributes, $2^4=16$ attribute profiles were determined.

Since there is no hierarchy in the profiles created on the basis of Fields, the attribute profiles are determined as shown in Table 5.

Table 5: Six-teen Attribute Profiles for The Clinical Medical Sciences Test Created Based on The Fields

P1	0	0	0	0	P9	0	1	1	0
P2	1	0	0	0	P10	0	1	0	1
P3	0	1	0	0	P11	0	0	1	1
P4	0	0	1	0	P12	1	1	1	0
P5	0	0	0	1	P13	1	1	0	1
P6	1	1	0	0	P14	1	0	1	1
P7	1	0	1	0	P15	0	1	1	1
P8	1	0	0	1	P16	1	1	1	1

White areas in Table 5 show the profiles included in the test. As shown in Table 5, there are questions related to profiles P2, P3, P4, P5, P7, and P9. Since 42 questions represent profile P2 and the number of questions has to be reduced by half, the first 21 questions of this group, the first 15 questions of the 30 questions representing profile P3, the first 15 questions of the 31 questions representing profile P4, the first 6 questions of the 12 questions representing profile P5, the first 2 questions of the 4 questions representing profile P7 and the single question representing profile P9 have been included, giving a total of 60 questions.

The Q matrix for The Basic Medical Sciences Test created based on Miller was investigated. Questions related to each attribute profile were identified and ranked. Sixty questions were found to represent the P2 profile (1,0,0,0,0), and the last 30 questions were taken from here since the number of questions would be halved. In addition, the first 19 of the 39 questions representing the P3 profile (1,1,0,0), the first 10 of the 20 questions representing the P4 profile (1,1,1,0) and the single question representing the P5 profile (1,1,1,1) were also included, giving a total of 60 questions.

Since the profiles created based on Miller are in a linear hierarchy, the attribute profiles are determined as in the Table 6.

Table 6: Five Attribute Profiles for The Basic Medical Sciences Test Created Based on Miller

P1	0	0	0	0
P2	1	0	0	0
P3	1	1	0	0
P4	1	1	1	0
P5	1	1	1	1

The Q matrix for The Clinical Medical Sciences Test created based on Miller was investigated. Questions related to each attribute profile were identified and ranked. Twenty-one questions were found to represent the P2 profile (1,0,0,0,0), and the last 11 questions were taken from here since the number of questions would be halved. In addition, the first 5 of the 11 questions representing the P3 profile (1,1,0,0), the last 36 of the 72 questions representing the P4 profile (1,1,1,0) and the first 8 of the 16 questions representing the P5 profile (1,1,1,1) were also included, giving a total of 60 questions.

The Fields and Miller Q matrices for the Basic Medical Sciences Test and Clinical Medical Sciences Test, created based on expert opinions, are not attached in the article to keep their length reasonable. For those interested in accessing the Q matrices, it is sufficient to email the author for further information.

Data Analysis

In the data analysis, the error values, s and g parameters and classification accuracies of the high-order DINA model and the high-order DINO model, which have a higher-level structure between attributes, and the independent DINA and DINO models, which do not consider any hierarchical structure, were compared under different conditions. R 4.2.2 program and the G-DINA, openxlsx, doParallel, readxl packages were used for data analysis. In addition, Mixed Factorial ANOVA was used to compare the RMSEA values obtained for the models, the mean s and g parameters for the items and the classification accuracy of the test according to the simulation conditions. In addition, common effect plots were used to investigate the statistically significant four-way and three-way interactions identified by factorial ANOVA.

FINDINGS

The assumption of normality was investigated before the analyzes were carried out. Kurtosis and skewness coefficients were taken into account in examining the condition of showing the normality assumption of the distribution of the parameters investigated at the levels of the simulation conditions. As a result of the examinations, it was determined that the values for most of the parameters remained in the range of -1 and 1. Parameter distributions showing small deviations from normality were ignored in the analysis due to the fact that the number of observations per cell in the analysis to be made is more than 50.

1. The Analysis Results of The Basic Medical Sciences Test

1. a) The RMSEA values obtained for the model fit

The mean of the RMSEA values estimated according to the analysis models and simulation conditions for Basic Medical Sciences are presented in Table 7.

Table 7: RMSEA for Model Fit Under Different Simulation Conditions for Basic Medical Sciences Test

		RMSEA Values							
		DINA		DINO		HO-DINA		HO-DINO	
		Number of items	Number of items	Number of items	Number of items	Number of items	Number of items	Number of items	Number of items
Q matrix	N	60	120	60	120	60	120	60	120
	500	.035	.030	.030	.023	.037	.031	.029	.023
Fields	2000	.036	.033	.032	.024	.037	.033	.031	.024
	5000	.036	.034	.032	.026	.037	.034	.032	.026
	500	.066	.059	.032	.027	.067	.059	.032	.027
Miller	2000	.064	.067	.031	.029	.065	.067	.031	.029
	5000	.066	.065	.033	.030	.067	.065	.033	.030

Table 7 shows that the RMSEA values obtained under different simulation conditions for the Basic Medical Sciences Test are less than 0.08. In other words, all models analyzed under different simulation conditions show a good fit. It was determined that the RMSEA values obtained for the attributes determined based on Fields in the Q matrix are lower than the RMSEA values obtained for the attributes determined based on Miller. Therefore, it can be said that determining the attributes based on Fields in the Q matrix provides better results than determining them based on Miller. When analyzing for sample size, it was found that the differentiation of the sample did not change the model fit. Regarding the number of items, it was found that the RMSEA values obtained for 120 items are lower than the RMSEA values obtained for 60 items, indicating that the models fit better for 120 items. Mixed factorial ANOVA was carried out to determine whether the differences showed statistically significant differences. The results are shown in Table 8.

Table 8: Mixed Factorial ANOVA Results for RMSEA Values of Models in The Basic Medical Sciences Test

Source	Sum of Squares	df	Mean Square	F	p	η_p^2
Method	0.048	1	0.048	3489.603	0.000	0.856
Method * Qmatrix	0.023	1	0.023	1701.417	0.000	0.743
Method * Sample	0.000	2	0.000	2.146	0.118	0.007
Method * Item	0.000	1	0.000	11.745	0.001	0.020
Method * Qmatrix * Sample	0.000	2	0.000	0.755	0.471	0.003
Method * Qmatrix * Item	0.000	1	0.000	1.097	0.295	0.002
Method * Sample * Item	0.000	2	0.000	4.906	0.008	0.016
Method * Qmatrix * Sample * Item	0.000	2	0.000	1.875	0.154	0.006
Error	0.008	588	0.000			

*p<.01;

Table 8 shows that the interaction between "number of items, sample size and method" is statistically significant (p<0.01) for the Basic Medical Sciences Test. The common effect plots are presented in Figure 1 to investigate how the RMSEA values differ under different simulation conditions for the Basic Medical Sciences Test. Looking at Figure 1, it can be seen that the RMSEA values for 120 items are lower than 60 items in all models; furthermore, the RMSEA values obtained for DINA and HO-DINA are similar to each other, and the RMSEA values obtained for DINO and HO-DINO are similar to each other. It is also seen that the results are very similar for the samples. It is observed that the RMSEA values for DINA and HO-DINA are higher than those for DINO and HO-DINO. Therefore, it can be noted that DINO and HO-DINO models give better results. For the Q-matrix determined by Fields, the

RMSEA values are similar for all models, whereas, for the Q-matrix determined by Miller's, the RMSEA values for DINO and HO-DINO are lower than those for DINA and HO-DINA. In addition, it is revealed that the RMSEA values obtained within the models of DINO and HO-DINO for the Q matrix determined based on Miller are very similar to the RMSEA values obtained for the Q matrix determined based on the Fields. Considering that the RMSEA values given by the models for the Q matrix determined based on the Fields are more consistent with each other and lower than the RMSEA values obtained for the Q matrix determined based on Miller, it can be interpreted that it is more advantageous to use the Q matrix determined based on the Fields for the TUS exam.
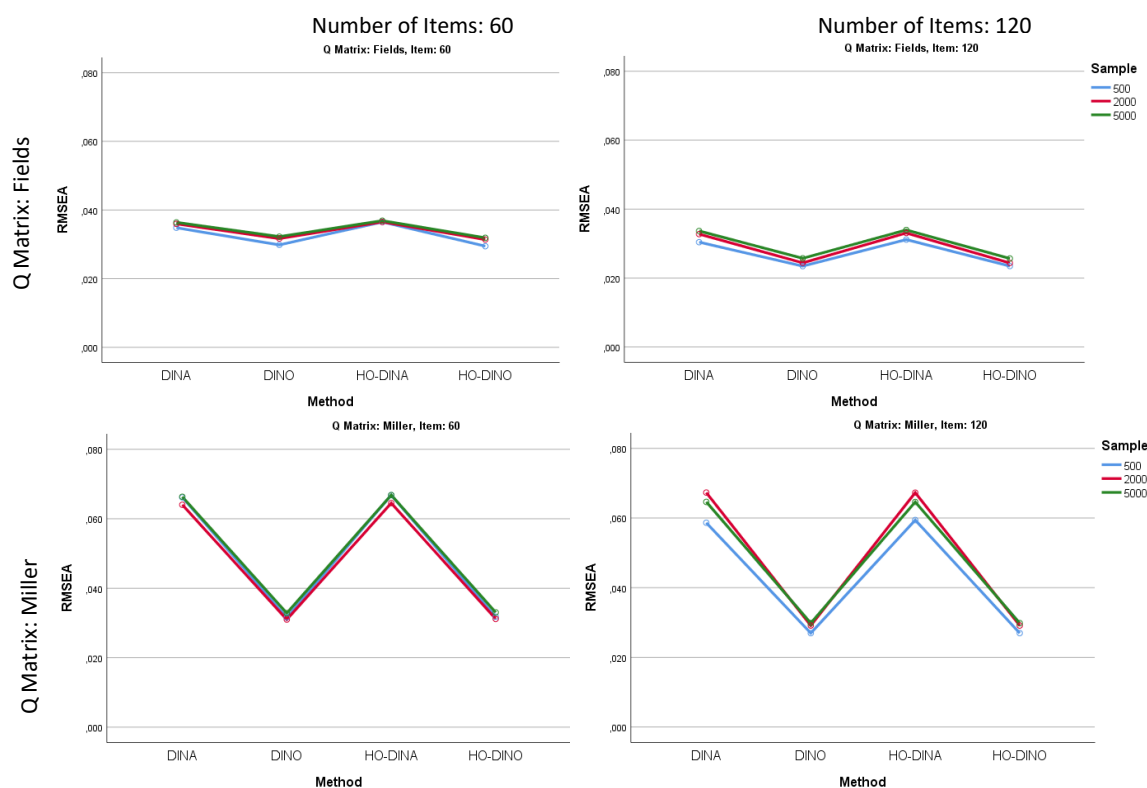
Figure 1: RMSEA Values for The Basic Medical Sciences Test Under Simulation Conditions.

1. b) g and s item parameter estimates

The mean values of the estimated g and s item parameter values for the Basic Medical Sciences Test according to the analysis models and simulation conditions are presented in Table 9.

Table 9: The Mean Values of s and g Item Parameters for The Basic Medical Sciences Test Under Different Simulation Conditions.

			DINA		DINO		HO-DINA		HO-DINO	
			Number of Items		Number of Items		Number of Items		Number of Items	
	Q matrix	N	60	120	60	120	60	120	60	120
s parameters	Fields	500	.176	.121	.208	.208	.177	.122	.207	.208
		2000	.170	.124	.204	.207	.168	.124	.204	.207
		5000	.168	.126	.204	.210	.167	.126	.204	.210
	Miller	500	.158	.149	.234	.250	.158	.150	.234	.250
		2000	.165	.164	.242	.249	.166	.165	.242	.249
		5000	.163	.163	.237	.250	.163	.163	.237	.250
g parameters	Fields	500	.207	.223	.109	.102	.206	.222	.110	.102
		2000	.211	.220	.111	.102	.212	.220	.111	.102
		5000	.212	.216	.115	.102	.212	.217	.115	.102
	Miller	500	.216	.210	.121	.108	.216	.209	.121	.109
		2000	.209	.208	.117	.109	.209	.208	.116	.109
		5000	.211	.207	.120	.107	.211	.207	.120	.107

If Table 9 is investigated, it can be seen that the g parameter values obtained for the Basic Medical Sciences Test under different simulation conditions are between 0.102 and 0.223, and the s parameters are between 0.121 and 0.250. In other words, since the g and s parameter values analyzed under different simulation conditions are low, all models show a good fit. It is found that the g and s parameter values obtained for the attributes determined based on the Fields in the Q matrix are lower than the g and s parameter values obtained for the attributes determined based on the Miller. Therefore, it can be said that determining attributes

based on the Fields in the Q-matrix gives better results than determining them based on Miller. Regarding the sample size, it is found that there is not much difference in the s and g parameters with the differentiation of the sample, so it does not affect the model fit. Concerning the number of items, it is noted that the g parameter values obtained with 60 items are similar to that obtained with 120 items. The g and s parameter values for the Fileds and Miller indicate that the model fit of the test is sufficient. Mixed Factorial ANOVA was conducted to investigate whether the differences showed statistically significant. The results are presented in Table 10.

Table 10: Mixed Factorial ANOVA Results of g and s parameters for Models in The Basic Medical Sciences Test

	Source	Sum of Squares	df	Mean Square	F	p	η_p^2
g parameters	Method	1.250	1	1.250	20725.234	0.000	0.972
	Method * Qmatrix	0.004	1	0.004	67.712	0.000	0.103
	Method * Sample	0.000	2	0.000	1.438	0.238	0.005
	Method * Item	0.005	1	0.005	90.396	0.000	0.133
	Method * Qmatrix* Sample	0.000	2	0.000	0.471	0.625	0.002
	Method * Qmatrix* Item	0.001	1	0.001	19.524	0.000	0.032
	Method * Sample * Item	0.000	2	0.000	0.187	0.829	0.001
	Method * Qmatrix* Sample * Item	0.000	2	0.000	0.522	0.594	0.002
	Error	0.035	588	0.000			
s parameters	Method	0.612	1	0.612	4525.787	0.000	0.885
	Method * Qmatrix	0.018	1	0.018	135.088	0.000	0.187
	Method * Sample	0.001	2	0.000	1.912	0.149	0.006
	Method * Item	0.033	1	0.033	241.146	0.000	0.291
	Method * Qmatrix * Sample	0.000	2	0.000	1.331	0.265	0.005
	Method * Qmatrix * Item	0.010	1	0.010	70.374	0.000	0.107
	Method * Sample * Item	0.001	2	0.000	2.569	0.077	0.009
	Method * Qmatrix * Sample * Item	0.000	2	0.000	0.729	0.483	0.002
	Error	0.080	588	0.000			

*p<.01;

Table 10 shows that the interaction between the "number of items, Q matrix and method" for g parameters in the Basic Medical Sciences Test is statistically significant (p<0.01). The common effect plots are presented in Figure 2 to investigate how the g item parameters differ under different simulation conditions for the Basic Medical Sciences Test. Figure 2 shows that for all models, the g item parameters are similar for both 120 and 60 items; furthermore, g parameter values obtained for DINA and HO-DINA are similar to each other and g parameter values obtained for DINO and HO-DINO are similar to each other. In addition, the results for different samples are very similar. The g parameters obtained for the DINO and HO-DINO models are observed to be lower than those obtained for the DINA and HO-DINA models. Furthermore, while considering the Q matrix determined based on Fields and Miller, the g parameters obtained for all models are similar, and the g parameters obtained for DINO and HO-DINO models are lower than those obtained for DINA and HO-DINA models for the Q matrix determined based on Fields and Miller.
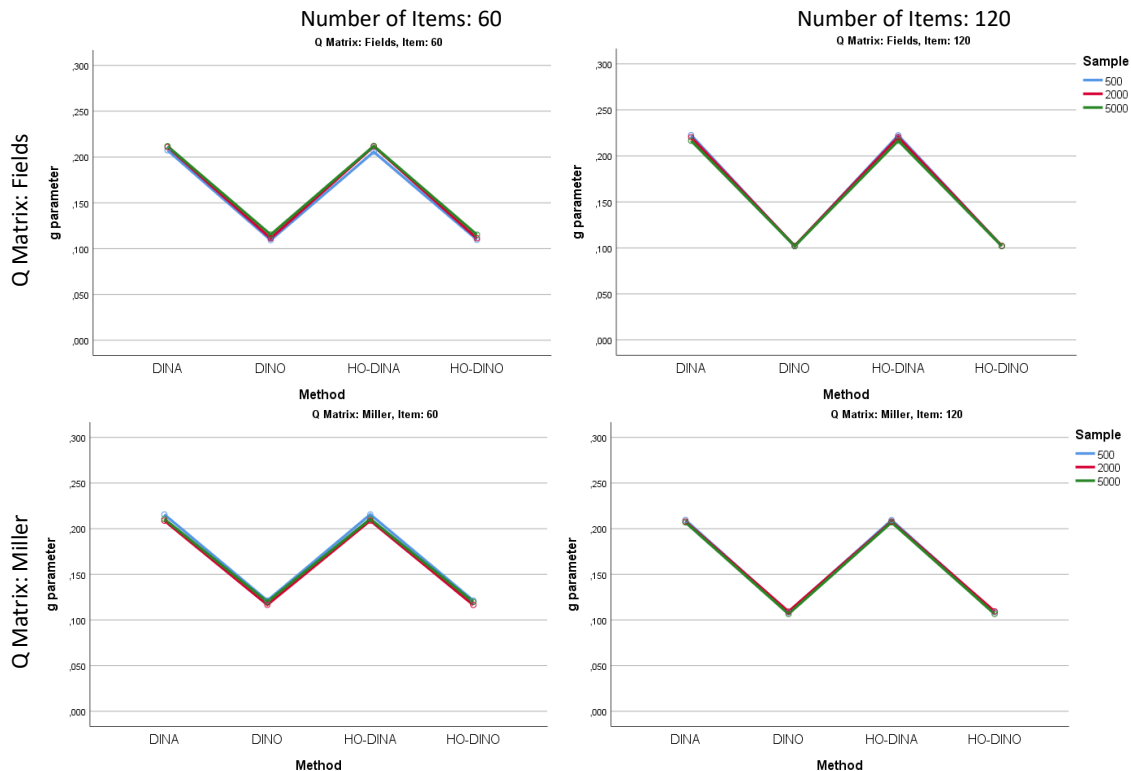
Figure 2: g Parameter Values for The Basic Medical Sciences Test under Different Simulation Conditions

Table 10 shows that the interaction between "number of items, Q-matrix and method" is statistically significant (p<0.01) for the s item parameters in the Basic Medical Sciences Test. The common effect plots are presented in Figure 3 to investigate how the s item parameters differ under different simulation conditions for the Basic Medical Sciences Test. Looking at Figure 3, it can be seen that for all models, the s item parameters are similar for both 120 items and 60 items. Additionally, the results for different samples are very similar. Moreover, when considering the Q matrix determined based on Fields and Miller, it is observed that the s item parameters obtained for all models are very similar.
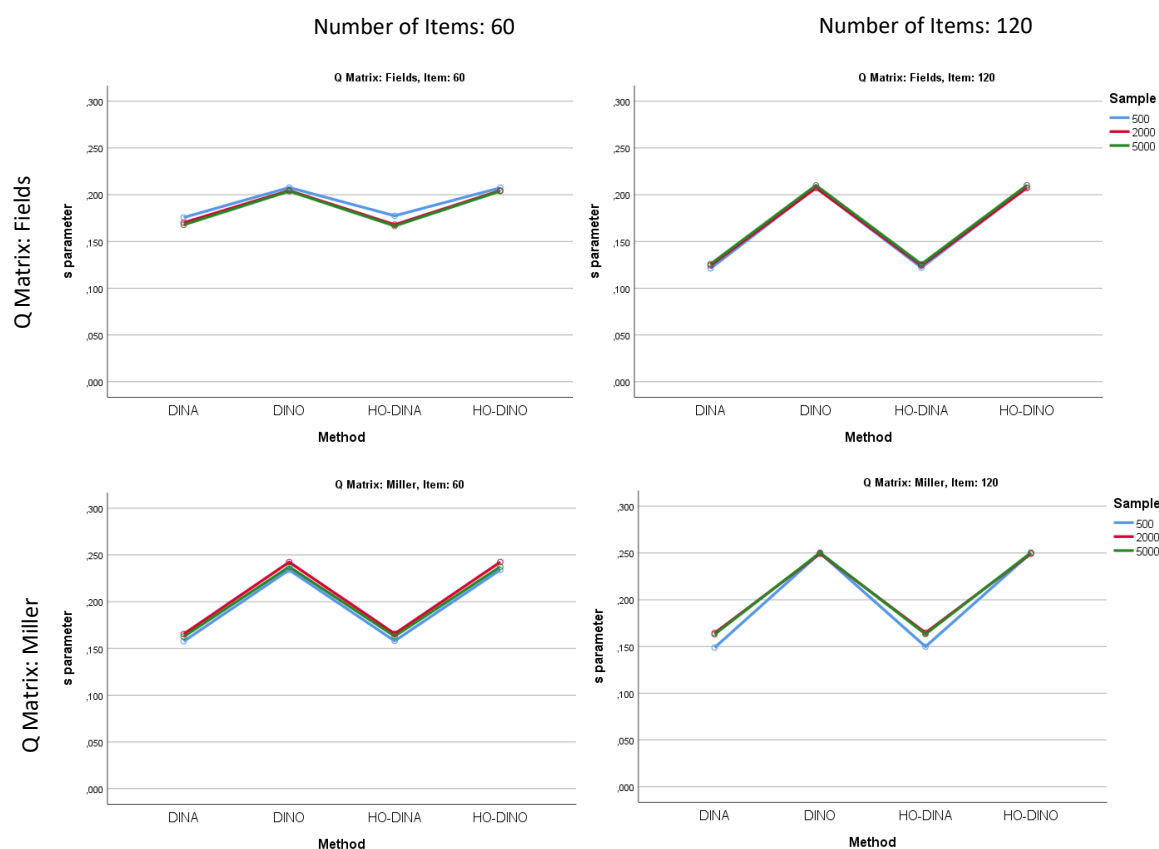
Figure 3: s Parameter Values for the Basic Medical Sciences Test under Different Simulation Conditions

1. c) Classifying accuracy

The mean values of the estimated classification accuracies for The Basic Medical Sciences Test according to the analysis models and simulation conditions are presented in Table 11.

Table 11: The Mean Values of Correct Classification Rates for The Basic Medical Sciences Test Under Different Simulation Conditions

		DINA classification rates		DINO classification rates		HO-DINA classification rates		HO-DINO classification rates	
		Number of Items		Number of Items		Number of Items		Number of Items	
Q matrix	N	60	120	60	120	60	120	60	120
	500	.837	.921	.914	.970	.806	.907	.898	.965
Fields	2000	.815	.903	.893	.966	.800	.896	.888	.964
	5000	.806	.904	.886	.964	.798	.900	.883	.963
	500	.282	.280	.528	.551	.404	.400	.562	.565
Miller	2000	.277	.279	.533	.561	.386	.386	.572	.577
	5000	.276	.289	.538	.557	.384	.385	.569	.570

Looking at Table 11, it can be seen that the values of the classification rates obtained for the attributes based on the Fields in the Q-matrix under different simulation conditions in The Basic Medical Sciences Test are between 0.798 and 0.970, and the values of the classification rates obtained for the attributes based on Miller are between 0.276 and 0.577. Accordingly, it can be interpreted that the attribute determination based on Fields in the Q-matrix gives better results than the attribute determination based on Miller. Regarding the sample size, it is noted that the variation in the sample did not affect the classification rates. On the other hand, in terms of the number of items, it was found that the classification rates obtained for 120 items were higher than the classification rates obtained for 60 items. Mixed factorial ANOVA was conducted to investigate whether the determined differences showed statistically significant. The results are presented in Table 12.

Table 12: Mixed Factorial ANOVA Results of Classification Rates of Models in The Basic Medical Sciences Test

Source	Sum of Squares	df	Mean Square	F	p	η_p^2
Method	5.026	1	5.026	7586.985	0.000	0.928
Method * Qmatrix	2.747	1	2.747	4146.263	0.000	0.876
Method * Sample	0.006	2	0.003	4.209	0.015	0.014
Method * Item	0.004	1	0.004	5.949	0.015	0.010
Method * Qmatrix * Sample	0.005	2	0.003	4.142	0.016	0.014
Method * Qmatrix * Item	0.000	1	0.000	0.434	0.511	0.001
Method * Sample * Item	0.002	2	0.001	1.224	0.295	0.004
Method * Qmatrix * Sample * Item	0.000	2	0.000	0.076	0.927	0.000
Error	0.390	588	0.001			

*p<.01;

Table 12 indicates that there is a statistically significant interaction between the "Q-matrix and method" in the Basic Medical Sciences Test (p < 0.01). The common effect plots are presented in Figure 4 to investigate how the classification accuracies differ under different simulation conditions for The Basic Medical Sciences Test. Looking at Figure 4, it can be seen that for all models, the classification accuracies for 120 items are higher than those for 60 items based on the Fields in the Q-matrix. Moreover, when comparing the models based on Miller, the classification accuracies for both 120 and 60 items are similar. The classification accuracies obtained for the DINA and HO-DINA models are similar to those obtained for the DINO and HO-DINO models. In addition, the results for different samples are very similar. Furthermore, the classification accuracies obtained for the DINO and HO-DINO models are higher than those for the DINA and HO-DINA models. For the Q-matrix determined by Fields, the classification accuracy values are similar for all models, whereas, for the Q-matrix determined by Miller's, the classification accuracy values for the DINO and HO-DINO models are higher than those for the DINA and HO-DINA models. In addition, it can be seen that the classification accuracies obtained by all models for the Q-matrix determined by Fields are higher than the classification accuracies obtained for the Q-matrix determined by Miller. Considering that the classification accuracy values given by the models for the Q matrix determined based on the Fields are more consistent with each other and higher than the classification accuracy values obtained for the Q matrix determined based on Miller, it can be interpreted that it is more advantageous to use the Q matrix determined based on the Fields for the TUS exam.

Figure 4: Classification Accuracy Values for The Basic Medical Sciences Test under Different Simulation Conditions

2. Analysis Results of The Clinical Medical Sciences Test

2. a) The RMSEA values obtained for the model fit

The mean of the RMSEA values estimated according to the analysis models and simulation conditions for Clinical Medical Sciences are presented in Table 13.

Table 13: RMSEA for Model Fit Under Different Simulation Conditions for The Clinical Medical Sciences Test

		RMSEA Values							
		DINA		DINO		HO-DINA		HO-DINO	
		Number of items		Number of items		Number of items		Number of items	
Q matrix	N	60	120	60	120	60	120	60	120
Fields	500	.005	.006	.003	.004	.005	.007	.003	.004
	2000	.007	.007	.004	.005	.007	.007	.004	.005
	5000	.006	.007	.004	.005	.007	.007	.004	.005
Miller	500	.074	.079	.049	.047	.075	.080	.049	.047
	2000	.073	.078	.049	.048	.073	.078	.049	.048
	5000	.070	.073	.050	.048	.071	.074	.050	.048

Table 13 shows that the RMSEA values obtained under different simulation conditions for The Clinical Medical Sciences Test are less than 0.08. In other words, all models analyzed under different simulation conditions show a good fit. It was determined that the RMSEA values obtained for the attributes determined based on Fields in the Q matrix are lower than the RMSEA values obtained for the attributes determined based on Miller. Therefore, it can be said that determining the attributes based on Fields in the Q matrix provides better results than determining them based on Miller. When analyzing for sample size, it was found that the differentiation of the sample did not change the model fit. Regarding the number of items, it was found that the RMSEA values obtained for 60 items are lower than the RMSEA values obtained for 120 items, indicating that the models fit better for 60 items. Mixed Factorial ANOVA was carried out to determine whether the differences showed statistically significant differences. The results are shown in Table 14.

Table 14: Mixed Factorial ANOVA Results for RMSEA Values of Models in The Clinical Medical Sciences Test

Source	Sum of Squares	df	Mean Square	F	p	η_p^2
Method	0.023	1	0.023	2272.335	0.000	0.794
Method * Qmatrix	0.017	1	0.017	1662.000	0.000	0.739
Method * Sample	0.000	2	0.000	8.389	0.000	0.028
Method * Item	0.000	1	0.000	28.764	0.000	0.047
Method * Qmatrix * Sample	0.000	2	0.000	10.026	0.000	0.033
Method * Qmatrix * Item	0.000	1	0.000	22.164	0.000	0.036
Method * Sample * Item	0.000	2	0.000	0.385	0.681	0.001
Method * Qmatrix * Sample * Item	0.000	2	0.000	0.177	0.838	0.001
Error	0.006	588	0.000			

*p<.01;

Table 14 shows that the interaction between "number of items, Q matrix and method" and "sample size, Q matrix and method" are statistically significant (p<0.01) for The Clinical Medical Sciences Test. The common effect plots are presented in Figure 5 to investigate how the RMSEA values differ under different simulation conditions for The Clinical Medical Sciences Test. Looking at Figure 5, it can be seen that for all models, the RMSEA values are similar for both 120 and 60 items; furthermore, the RMSEA values obtained for DINA and HO-DINA are similar to each other, and the RMSEA values obtained for DINO and HO-DINO are similar to each other. It is also seen that the results are very similar for the samples. It is observed that the RMSEA values for DINA and HO-DINA are higher than those for DINO and HO-DINO. Therefore, it can be noted that DINO and HO-DINO models give better results. For the Q-matrix determined by Fields, the RMSEA values are similar for all models, whereas, for the Q-matrix determined by Miller's, the RMSEA values for DINO and HO-DINO are lower than those for DINA and HO-DINA. Considering the more consistent results between the models and lower RMSEA values obtained for the Q matrix determined by Fields, it can be concluded that the Q matrix based on Fields is more advantageous for the TUS exam.

Number of Items: 60   Number of Items: 120
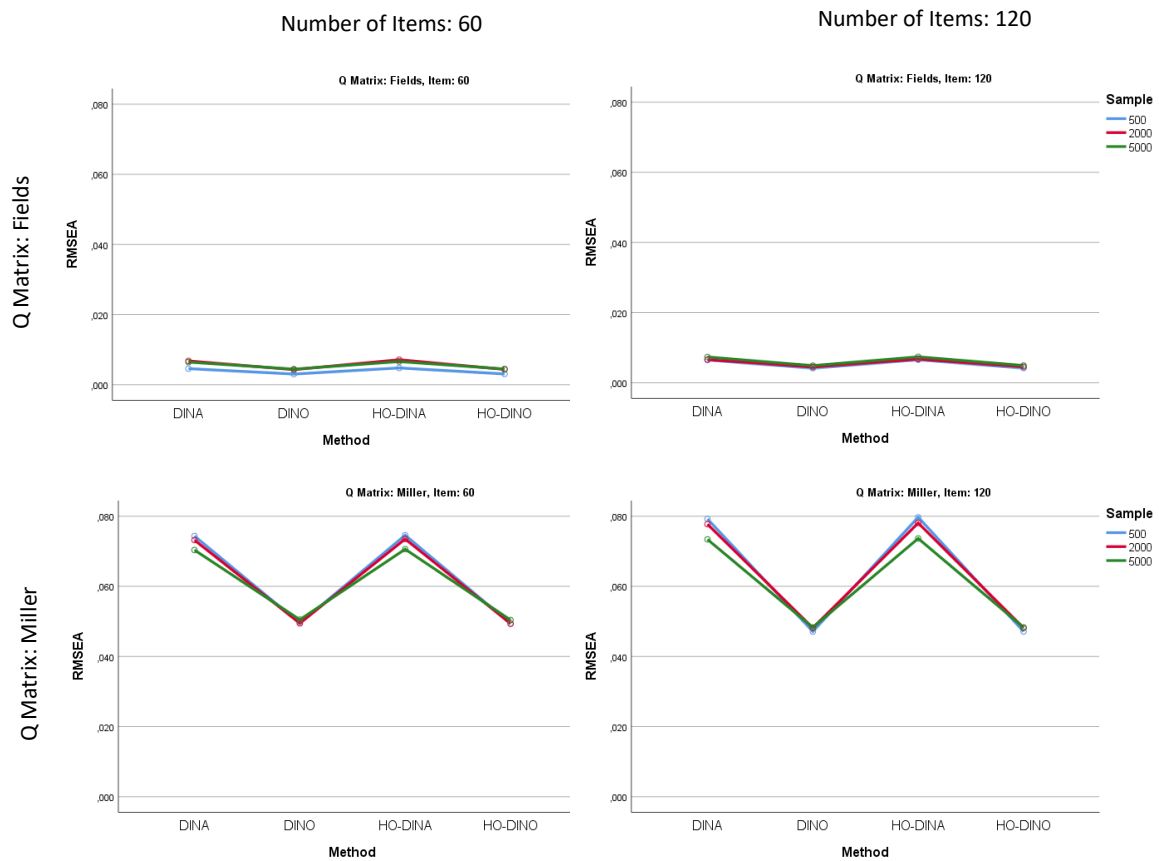
Figure 5: RMSEA Values for The Clinical Medical Sciences Test under Simulation Conditions.

2. b) g and s item parameter estimates

The mean values of the estimated g and s item parameter values for The Clinical Medical Sciences Test according to the analysis models and simulation conditions are presented in Table 15.

Table 15: The Mean Values of s and g Item Parameters for The Clinical Medical Sciences Test under Different Simulation Conditions.

			DINA		DINO		HO-DINA		HO-DINO	
			Number of Items		Number of Items		Number of Items		Number of Items	
	Q matrix	N	60	120	60	120	60	120	60	120
s parameters		500	.099	.100	.114	.112	.099	.100	.114	.112
	Fields	2000	.100	.100	.114	.112	.100	.100	.114	.112
		5000	.100	.100	.115	.113	.100	.100	.115	.113
		500	.270	.166	.298	.301	.270	.166	.298	.301
	Miller	2000	.282	.191	.296	.305	.282	.191	.296	.305
		5000	.293	.220	.297	.307	.293	.220	.297	.307
g parameters		500	.113	.111	.100	.100	.113	.111	.100	.100
	Fields	2000	.114	.111	.100	.100	.114	.111	.100	.100
		5000	.113	.111	.100	.100	.113	.111	.100	.100
		500	.311	.399	.137	.136	.311	.399	.137	.136
	Miller	2000	.304	.379	.139	.135	.304	.379	.139	.135
		5000	.303	.355	.138	.138	.302	.355	.138	.138

If Table 15 is investigated, it can be seen that the g parameter values obtained for The Clinical Medical Sciences Test under different simulation conditions are between 0.100 and 0.399, and the s parameters are between 0.099 and 0.307. In other words, since the g and s parameter values analyzed under different simulation conditions are low, all models show a good fit. It is found that the g and s parameter values obtained for the attributes determined based on the Fields in the Q matrix are lower than the g and s parameter values obtained for the attributes determined based on the Miller. Therefore, it can be said that determining attributes based on the Fields in the Q-matrix gives better results than determining them based on Miller. Regarding the sample size, it is found that there is not much difference in the s and g parameters with the differentiation of the sample, so it does not affect the model fit. Concerning the number of items, it is noted that the g and s parameter values obtained with 60 items are similar to that obtained with 120 items. The g and s parameter values for the Fields and Miller indicate that the model fit of the

test is sufficient. Mixed Factorial ANOVA was conducted to investigate whether the determined differences showed statistically significant. The results are presented in Table 16.

Table 16: Mixed Factorial ANOVA Results of g and s Parameters for Models in The Clinical Medical Sciences Test

	Source	Sum of Squares	df	Mean Square	F	p	η_p^2
g parameters	Method	1.403	1	1.403	5032.676	0.000	0.895
	Method * Qmatrix	1.114	1	1.114	3995.073	0.000	0.872
	Method * Sample	0.004	2	0.002	6.562	0.002	0.022
	Method * Item	0.038	1	0.038	135.127	0.000	0.187
	Method * Qmatrix* Sample	0.004	2	0.002	6.748	0.001	0.022
	Method * Qmatrix* Item	0.042	1	0.042	151.875	0.000	0.205
	Method * Sample * Item	0.002	2	0.001	3.303	0.037	0.011
	Method * Qmatrix* Sample * Item	0.002	2	0.001	3.258	0.039	0.011
	Error	0.164	588	0.000			
s parameters	Method	0.178	1	0.178	433.566	0.000	0.424
	Method * Qmatrix	0.075	1	0.075	181.597	0.000	0.236
	Method * Sample	0.006	2	0.003	7.454	0.001	0.025
	Method * Item	0.067	1	0.067	162.805	0.000	0.217
	Method * Qmatrix * Sample	0.006	2	0.003	7.543	0.001	0.025
	Method * Qmatrix * Item	0.073	1	0.073	177.461	0.000	0.232
	Method * Sample * Item	0.001	2	0.000	0.955	0.385	0.003
	Method * Qmatrix * Sample * Item	0.001	2	0.000	1.031	0.357	0.003
	Error	0.242	588	0.000			

*p<.01;

Table 16 shows that the interaction between "number of items, Q matrix and method" and "sample size, Q matrix and method" for g parameters in The Clinical Medical Sciences Test are statistically significant (p<0.01). To investigate how the g item parameters differ under different simulation conditions for The Clinical Medical Sciences Test, common effect plots are presented in Figure 6. Figure 6 shows that for all models, the g parameters are similar for both 120 and 60 items, furthermore g parameter values obtained for DINA and HO-DINA are similar to each other and g parameter values obtained for DINO and HO-DINO are similar to each other. In addition, the results for different samples are very similar. The g parameters obtained for the DINO and HO-DINO models are observed to be lower than those obtained for the DINA and HO-DINA models. Furthermore, while considering the Q matrix determined based on Fields, the g item parameters obtained for all models are similar; the g item parameters obtained for DINO and HO-DINO models are lower than those obtained for DINA and HO-DINA models for the Q matrix determined based on Miller.
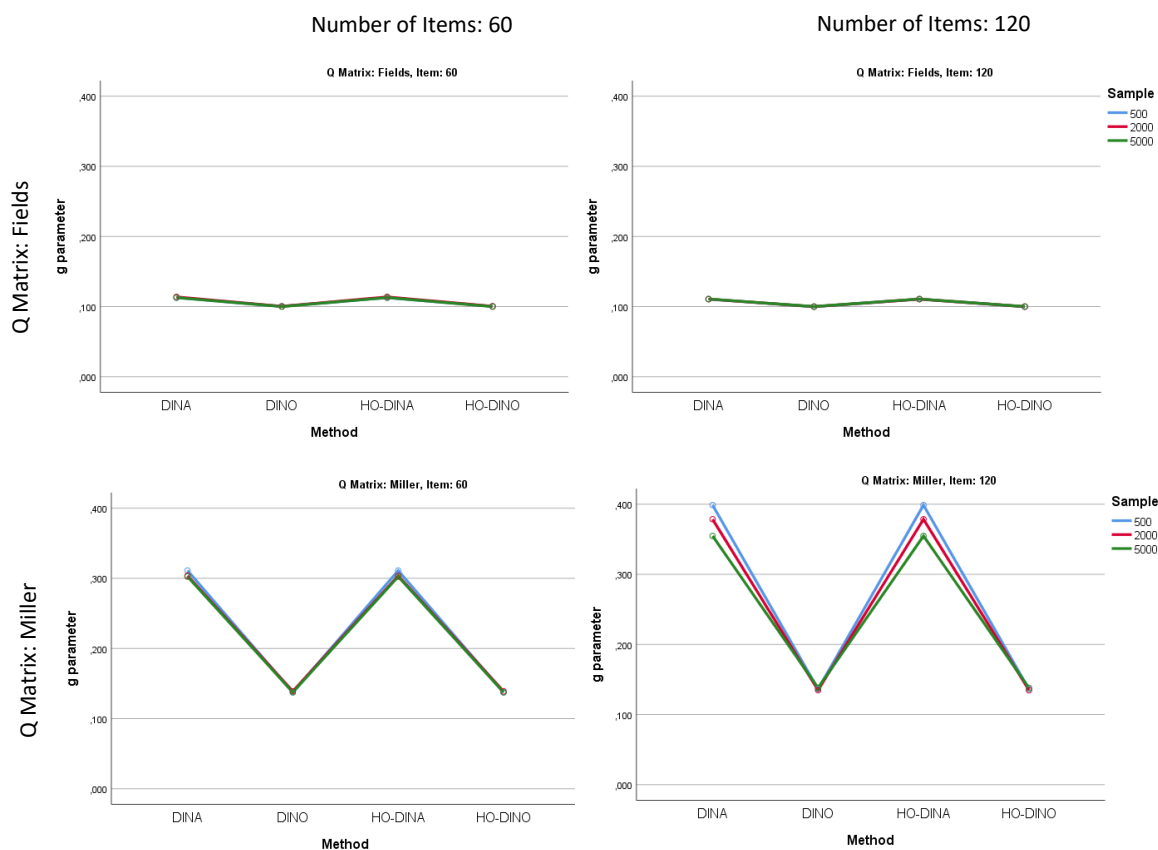
Figure 6: g Parameter Values for The Clinical Medical Sciences Test under Different Simulation Conditions

Table 16 shows that the interaction between "number of items, Q matrix and method" and "sample size, Q matrix and method" are statistically significant ($p<0.01$) for the s item parameters in The Clinical Medical Sciences Test. To investigate how the s item parameters differ under different simulation conditions for The Clinical Medical Sciences Test, common effect plots are presented in Figure 7. Looking at Figure 7 it can be seen that for all models considering the Q matrix determined based on Fields, the s parameters are similar for both 120 items and 60 items, furthermore the s item parameters for 120 items obtained for DINO and HO-DINO models are higher than those obtained for DINA and HO-DINA models in the Q matrix determined based on Miller. In addition, the results for different samples are very similar. In the Q matrix determined based on Miller, it was found that the s item parameters for 120 items obtained for DINA and HO-DINA models are lower than the s item parameters for 60 items obtained for DINA and HO-DINA models. In addition, it was determined that the s parameter values obtained for 60 and 120 items for the DINO and HO-DINO models are similar in the Q matrix determined based on Miller.
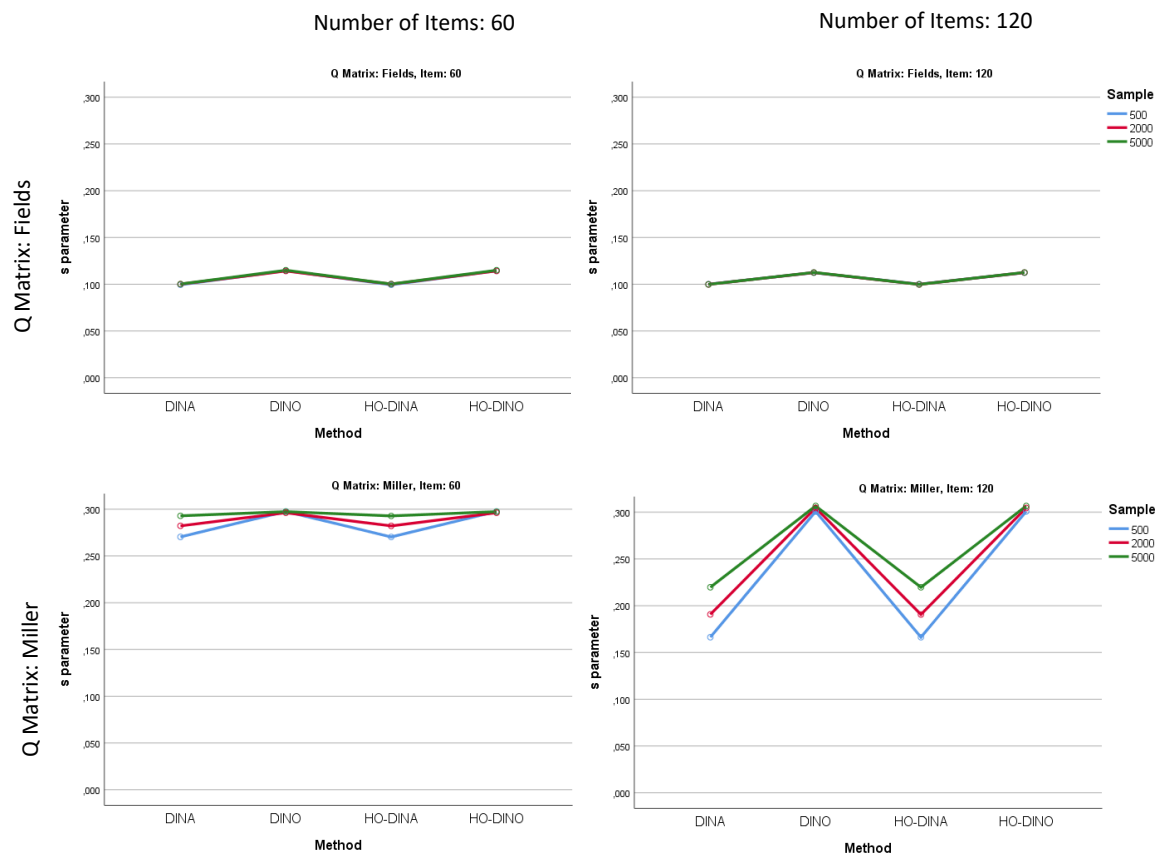
Figure 7: s Parameter Values for The Clinical Medical Sciences Test under Different Simulation Conditions

2. c) Classifying accuracy

The mean values of the estimated classification accuracies for The Clinical Medical Sciences Test according to the analysis models and simulation conditions are presented in Table 17.

Table 17: The Mean Values of Correct Classification Rates for The Clinical Medical Sciences Test under Different Simulation Conditions

		DINA classification rates		DINO classification rates		HO-DINA classification rates		HO-DINO classification rates	
		Number of Items		Number of Items		Number of Items		Number of Items	
Q matrix	N	60	120	60	120	60	120	60	120
Fields	500	.996	1.000	.996	1.000	.996	1.000	.996	1.000
	2000	.996	1.000	.996	1.000	.996	1.000	.996	1.000
	5000	.996	1.000	.996	1.000	.996	1.000	.996	1.000
Miller	500	.538	.492	.735	.807	.651	.579	.671	.688
	2000	.559	.499	.715	.809	.660	.583	.648	.687
	5000	.569	.519	.712	.812	.664	.602	.646	.679

Looking at Table 17, it can be seen that the values of the classification rates obtained for the attributes based on the Fields in the Q-matrix under different simulation conditions in The Clinical Medical Sciences Test are between 0.996 and 1.000, and the values of the classification rates obtained for the attributes based on Miller are between 0.519 and 0.812. Accordingly, it can be interpreted that the attribute determination based on Fields in the Q matrix gives better results than the attribute determination based on Miller. In other words, in the models analyzed under different simulation conditions, it was determined that the Fields were better classified than the Miller. Regarding the sample size, it is noted that the variation in the sample did not affect the classification rates. On the other hand, in terms of the number of items, it was found that for all models considering the Q matrix determined based on Fields, the classification rates obtained for 120 items were higher than the classification rates obtained for 60 items, furthermore the classification rates obtained for 60 items obtained for DINA and HO-DINA models were higher than the classification rates obtained for 120 items obtained for DINO and HO-DINO models in the Q matrix determined based on Miller. Mixed factorial ANOVA was conducted to investigate whether the determined differences showed statistically significant. The results are presented in Table 18.

Table 18: Mixed Factorial ANOVA Results of Classification Rates of Models in The Clinical Medical Sciences Test

Source	Sum of Squares	df	Mean Square	F	p	η_p^2
Method	0.590	1	0.590	526.640	0.000	0.472
Method * Qmatrix	0.591	1	0.591	526.991	0.000	0.473
Method * Sample	0.015	2	0.008	6.834	0.001	0.023
Method * Item	0.014	1	0.014	12.569	0.000	0.021
Method * Qmatrix * Sample	0.015	2	0.008	6.871	0.001	0.023
Method * Qmatrix * Item	0.014	1	0.014	12.525	0.000	0.021
Method * Sample * Item	0.002	2	0.001	0.936	0.393	0.003
Method * Qmatrix * Sample * Item	0.002	2	0.001	0.944	0.390	0.003
Error	0.659	588	0.001			

*p<.01;

Table 18 indicates that there is a statistically significant interaction between the "number of items, Q matrix and method" and "sample size, Q matrix and method" in The Clinical Medical Sciences Test (p < 0.01). The common effect plots are presented in Figure 8 to investigate how the classification accuracies differ under different simulation conditions for The Clinical Medical Sciences Test. Looking at Figure 8, it can be seen that for all models, the classification accuracies for both 120 and 60 items are similar. The classification accuracy values for the Q matrix determined by Fields are similar for all models. In contrast, for the Q matrix determined by Miller, the classification accuracy values obtained for DINA and HO-DINA are similar, and those obtained for DINO and HO-DINO are similar. In addition, the results for different samples are very similar. For the Q-matrix determined by Fields, the classification accuracy values are similar for all models, whereas, for the Q-matrix determined by Miller's, the classification accuracy values for the DINO and HO-DINO models are higher than those for the DINA and HO-DINA models. In addition, it can be seen that the classification accuracies obtained by all models for the Q matrix determined by Fields are higher than the classification accuracies obtained for the Q matrix determined by Miller. Considering that the classification accuracy values given by the models for the Q matrix determined based on the Fields are more consistent with each other and higher than the classification accuracy values obtained for the Q matrix determined based on Miller, it can be interpreted that it is more advantageous to use the Q matrix determined based on the fields for the TUS exam.

Number of Items: 60

Number of Items: 120

Figure 8: Classification Accuracy Values for The Basic Clinical Sciences Test under Different Simulation Conditions

CONCLUSION, DISCUSSION AND RECOMMENDATIONS

In this study, the impact of sample size, number of items, and different Q matrices on the RMSEA, g and s parameters, and classification accuracy of the DINA, HO-DINA, DINO, and HO-DINO models was investigated for a test applied in health education. As stated by De la Torre et al. (2010), the accurate estimation of item parameters and the accurate classification of attributes are of paramount importance for obtaining valid inferences in cognitive diagnosis, hence their importance.

The findings of the study revealed that when examining the RMSEA values of the DINA, HO-DINA, DINO, and HO-DINO models for The Basic Medical Sciences and Clinical Medical Sciences tests under different simulation conditions; it can be observed that the DINO and HO-DINO models provide a better fit to the data in all conditions. Hu et al. (2016) noted that model fit is affected by the misidentification of the Q matrix. Therefore, based on the findings, when analyzing the RMSEA values for The Basic Medical Sciences and Clinical Medical Sciences tests, it is evident that the Q matrix determined by Fields provides a better fit to the data, and moreover, it is advantageous for the Q matrix determined by Fields to be used for the TUS exam. When all conditions were analysed, it was determined that variations in the sample size for Basic Medical and Clinical Medical Sciences did not change the model fit. In addition, although the RMSEA values were similar in terms of the number of items, it was determined that the RMSEA values obtained for 120 items in Basic Medical Sciences were lower, while the RMSEA values obtained for 60 items in Clinical Medical Sciences were lower for the Q matrix determined based on the Fields. Accordingly, it was observed that there was no significant difference in model fit with respect to the number of items. When analysed in terms of the number of items for the Q matrix determined based on Miller, although the RMSEA values were similar, it was determined that the RMSEA values obtained for 120 items in some cases and for 60 items in some cases in Basic Medical Sciences and Clinical Medical Sciences were lower. It can be said that this situation is due to the fact that the Q matrix determined based on Miller is not suitable for the measurement tool used.

When examining the s and g parameters obtained from the DINA, HO-DINA, DINO and HO-DINO models for The Basic Medical Sciences and Clinical Medical Sciences tests, it was observed that the values of the g and s parameters are low in all conditions, indicating that all models have a good fit. It was found that the g and s parameter values obtained for the attributes determined based on the Fields in the Q matrix were lower than the g and s parameter values obtained for the attributes determined based on the Miller. Accordingly, it can be concluded that determining attributes based on the Fields in the Q matrix gives better results than determining attributes based on Miller. When analyzing the impact of sample size, it was found that there is not much difference in the s and g parameters as a result of sample variation. Similarly, when considering the number of items, the g and s parameter values obtained for 60 items were similar to those obtained for 120 items.

In terms of the classification accuracy obtained from the DINA, HO-DINA, DINO and HO-DINO models for The Basic Medical Sciences and Clinical Medical Sciences tests, it was found that classification accuracy determined by Fields for the Q matrix was

higher than those determined by Miller. Therefore, it has been revealed that determining the attributes in the Q matrix based on the Fields gives better results than the determination based on Miller. Given that the baseline exam in this study is the TUS exam, it is suggested that the Q matrix determined based on the Fields gives better results. However, it should be noted that the results of Q matrices may vary depending on the content and extent of the examination. In future studies, the results of Q matrices determined by considering different exams related to medical specialty can be investigated. Analyzing the impact of sample size, it was found that variations in the sample did not change the classification accuracy. When considering the number of items, although the classification accuracy is similar, the classification accuracy obtained for 120 items in Basic Medical Sciences and Clinical Medical Sciences for the Q matrix determined based on the Fields are higher than the classification accuracy obtained for 60 items. When analysed in terms of the number of items for the Q matrix determined based on Miller, although the classification accuracy is similar, it is determined that the classification rates obtained for 120 items in some cases and 60 items in some cases in Basic Medical Sciences and Clinical Medical Sciences are high. It can be said that this situation is due to the fact that the Q matrix determined based on Miller is not suitable for the measurement tool used. De la Torre et al. (2010) suggested to investigate the ideal test lengths required to obtain classification accuracy, and it is found that the classification accuracies are similar according to the number of items, but when there is a suitable Q matrix, the classification accuracy increases as the number of items increases. However, in the following studies, the impact of the number of items on classification accuracy can be examined by increasing the conditions for the number of items (e.g. 15-30-60-120 items).

When the Q matrices created for Fields and Miller in the Basic Medical and Clinical Medical Sciences test is analysed according to the model fit, it is seen that the parameters related to DINO, HO-DINO models give better results than DINA, HO-DINA models. Reviewing the literature, it is found that a DINA model with statistically independent qualities gives better results than compensatory models. However, Delatorre stated in his study in 2004 that it would be more appropriate to use the compensatory model in psychiatric or medical diagnosis. In parallel with the literature, DINO, HO-DINO models gave better results than the compensatory models in the medical tests used in this study. Based on all these findings, the sample variation did not change the RMSEA, g and s parameters and classification rates for DINA, HO-DINA, DINO and HO-DINO models. Consistent with these findings, De la Torre et al. (2010) found that small sample sizes are sufficient to accurately estimate DINA model parameters. In this study, in parallel with this finding, it is determined that the difference in the number of samples does not change the model parameters. In the literature (e.g., Sünbül & Adnan, 2013, Chiu, 2013), regarding the number of items, an improvement in values was generally observed as the number of items increased. In this study, in parallel with this finding, it is noted that there is an improvement in the values as the number of items increases for the Q matrix determined based on Fields that better fit the data. When examining Q matrices, it was seen that the Q matrix determined based on Fields gave better results than the Q matrix determined based on Miller. Therefore, it can be interpreted that using the Q matrix determined based on the fields for the TUS exam is more advantageous. Research (e.g., Rupp & Templin, 2008) has indicated that the number of attributes measured by an item and the proportion of items measuring an attribute can impact estimation accuracy. In this study, since the number of items was reduced to 60 without changing the proportion of items related to the profiles, there may not have been a difference in classification accuracy. Therefore, when the number of items is reduced in the following studies, it can be taken as a random and equal proportion, and the results can be compared.

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

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

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| Research Article / Araştırma Makalesi|

An Investigation of the Psychological Need Satisfaction Levels of Foster Families

Koruyucu Ailelerin Psikolojik İhtiyaç Doyum Düzeylerinin İncelenmesi

Bilgin Kıray Vural[1], Özlem Körükçü[2], Gülay Taşdemir Yiğitoğlu [3]

Abstract

Purpose: This study aimed to investigate the psychological need satisfaction levels of foster families.

Design/Methodology/Approach: The present study is descriptive and cross-sectional. Data were collected between July 1 and 30, 2020, from 138 volunteer foster parents living in Turkey.

Findings: The Need Satisfaction Scale was a significant difference was found by age group in the subscale and overall scale scores of the individuals participating in the study. Significant differences by families' educational status were only present in the Competence subscale. Significant differences by age at which they became foster families were found in the Autonomy subscale and overall scores, and significant differences by age of fostered child were found in the Competence and overall scores (p<.05). Foster families were determined to have higher need satisfaction totals and subscale scores.

Highlights: A healthy upbringing that enables children to become socially adapted and productive individuals is only possible if they grow up in a loving and caring family environment. Foster family care is the best protection method that can ensure this. The present study concludes that the foster families studied here had high levels of psychological need satisfaction, had established desirable human relations, and were autonomous and competent.

Öz

Çalışmanın amacı: Koruyucu ailelerin psikolojik ihtiyaç doyumlarının belirlenmesi çalışmanın amacıdır.

Materyal ve Yöntem: Bu çalışma tanımlayıcı ve kesitseldir. Veriler 1-30 Temmuz 2020 tarihleri arasında Türkiye'de yaşayan 138 gönüllü koruyucu aileden toplanmıştır.

Bulgular: Araştırmaya katılan bireylerin yaş gruplarına göre İhtiyaç Doyum Ölçeği alt boyut ve toplam ölçek puanlarında anlamlı bir farklılık saptanmıştır. Ailelerin eğitim durumlarına göre sadece Yeterlik alt boyutunda anlamlılık olduğu saptanmıştır. Ailelerin koruyucu aile olduğu zamanki yaşına göre Özerklik alt boyut ve genel toplam puanlarında; bakımını üstlendiği çocuğun yaşına göre Yeterlik ve toplam puanlarında anlamlılık olduğu tespit edilmiştir (p<.05). Koruyucu ebeveynlerin ihtiyaç doyum toplam ve alt boyut puanlarının yüksek olduğu belirlenmiştir.

Önemli Vurgular: Çocukların sosyal olarak uyumlu ve üretken bireyler olmaları, ancak sağlıklı, sevgi dolu ve şefkatli bir aile ortamında büyümeleri ile mümkündür. Koruyucu aile bakımı, bunu sağlayabilecek en iyi koruma yöntemidir. Bu çalışmada koruyucu ailelerin yüksek düzeyde psikolojik ihtiyaç doyumuna sahip oldukları, arzu edilen şekilde insan ilişkileri kurdukları, özerk ve yetkin oldukları sonucuna varılmıştır.

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INTRODUCTION

The foster care model has been implemented in Turkey and in developed countries as a solution for children who would otherwise grow up in an orphanage, to offer them an opportunity to live in a warm family environment (Erol, 2011; Stone, Jackson, Nose and Huffhines, 2020). It is essential that this service provided for children under the state's protection is rights-based and that the state offers these rights through professionals (Reçber, 2019). According to Child Protection Law No. 5395, measures are taken in relation to the pillars of consultancy, education, care, health, and accommodation to protect and provide care for children, principally in a family environment.

If the individual responsible for the care of a child fails to fulfill their duty for any reason, it is determined that the child will benefit from official or private care or foster-family services or will be placed in one of these institutions (Child Protection Law No. 5395, 2005). The state provides care for children in need of protection through various protection measures, including institutional care, adoption, and foster care. A healthy upbringing that enables children to become socially adapted and productive individuals is only possible if they grow up in a loving and caring family environment (Pannilage, 2017). Foster family care is the best protection method that can ensure this (Akbulut Kurtuluş, 2011).

Children who are separated from their biological families may have had unpleasant experiences related to secure attachment in their lives or traumas arising from oppression and abuse; thus, this change is incredibly stressful for the child. Ultimately, not only do they leave people they are familiar with, but their whole surroundings change suddenly (Ebel, 2009). The foster family care environment aims to help children compensate for their lack of healthy biological family and cope with developmental deficiencies (Jespersen, 2011).

Foster families must provide the conditions needed for the child's healthy development in all respects, follow child monitoring protocols as determined at intervals by the Ministry of Health, fulfill obligations regarding any assigned treatment plan, and act in cooperation with the foster family unit in implementing care (Foster Family Regulations, Article 15-1-a). Children demonstrate significantly positive development in psychosocial terms after being placed in foster families because they can engage with foster parents and have stable family relationships (Linderkamp, Schramm & Michau, 2009; Diouani-Streek & Salgo, 2016).

To minimize problems, it is important to evaluate all aspects of the child and the family before determining eligibility (Erol, 2011). Characteristics of foster families that should be evaluated are whether they are autonomous, adequate, and have positive relationships with their environment-i.e., the level of their psychological need satisfaction. A high level of psychological need satisfaction is one of the most important factors for dealing with problems faced by foster families. Psychological needs are those that must be met at certain times and at certain levels for the individual to survive; if unmet, they lead to tension in the individual (Eysenck, Arnold & Meili, 1972; as cited in Hamurcu, 2011). Psychological need satisfaction is emphasized in studies based on subjective well-being (Ryan & Deci, 2000). According to the self-determination theory, which provides comprehensive explanations about psychological needs, psychological needs are crucially important in the development, integration, and health of a living being (İlhan & Özbay, 2010).

Autonomy, competence, and relatedness are cited as the three basic psychological needs; these needs are essential for human development, health, and personal integrity (Ryan & Deci, 2000). Autonomy refers to self-regulation and self-management (Morsünbül, 2012); it is the ability to make choices with the feeling that one has the freedom to express one's feelings and thoughts, to make the decisions in one's life, and to reveal one's true self. The autonomous person determines their own actions. Competence is the belief that one has the power and ability to perform a task and that one will be successful in that task. Relatedness means that the individual has close and sincere relationships with the people around them and thus has a sense of belonging. Satisfying these psychological needs contributes to an individual's success and the development of positive behaviors (Cihangir Çankaya, 2005).

Social work, which is defined as both a branch of art and a scientific discipline, is one of the humanitarian professions deemed by society as appropriate for helping improve the quality of life of all people (Duyan, 2003). Studies conducted on the foster parenting system within the field of social work aim to see how children can grow up with love in a happy family. For this reason, the present study examines the psychological need satisfaction levels of foster families who take care of children, which is considered important. According to the self-determination theory, all people have the same basic psychological needs; however, as needs can be interpreted differently in different cultures, they can be satisfied in different ways and to different degrees (Ryan & Deci, 2000). In this context, examining the psychological need satisfaction levels of foster families can be important in determining any possible cultural differences. At the same time, research findings suggest that this is an important topic of study, as it allows us to understand the needs of foster families.

During childhood, when the foundations of personality are laid, it is possible to develop a happy and peaceful child who can achieve satisfaction in relationships, with the help of identification models offered to them. For children to satisfy their psychological needs in a healthy way, foster parents should establish good relationships with their children. First of all, to satisfy children's psychological needs, foster parents—who are role models—should have high levels of psychological need satisfaction.

Various studies on the foster family model are available (Goemans, van Geel, & Vedder, 2018; Steenbakkers, Ellingsen, van der Steen, & Grietens, 2018; Stone, Jackson, Noser, & Huffhines, 2020). A review of the research studies on this subject in Turkey reveals such topics as: individuals' motives to become foster families (Bilican Gökkaya 2014; Tezel Demirel & Sahin Kaya, 2018); the impact of foster family services on biological children and foster families (Daşbaş, 2015); experiences and assessments of

custodial parents/members of foster family associations regarding the model (Erdugan, 2019, Gökdoğan Şahin, 2019); relevant experts' evaluations of the foster family program in Turkey (Şahin Kaya, 2019); treatment of childhood trauma within foster families (Abukan, 2020); and the problems of foster parents (Yıldırımalp & Hız, 2020).

A review of the studies on this subject in Turkey reveals such topics as individuals' motives for becoming foster families. No study is directly related to the psychological need satisfaction of foster parents. We predict that this study will contribute to the social service policies and practices that could be carried out in the field, both in terms of raising social awareness and of the welfare of the children placed in foster families.

The present study aimed to determine the psychological need satisfaction levels of foster families.

Research questions

This study has two research questions:

1. How is the psychological need satisfaction of foster parents defined within a framework of autonomy, competence, and relatedness?

2. How is the psychological need satisfaction of foster parents in terms of sociodemographic and certain other characteristics defined within a framework of autonomy, competence, and relatedness?

METHOD/MATERIALS

Design

This research was designed as a descriptive and cross-sectional study.

Participants

Participants in different provinces were recruited through snowball sampling. This method is used when it is difficult to access the individuals that make up the population of the research study or when information about the population is imperfect (Patton, 2005). Through foster family associations, we reached out to foster families in the provinces of Denizli (n=39), Uşak (n=4), İzmir (n=16), Samsun (n=5), Aydın (n=8), Afyonkarahisar (n=8), Manisa (n=8), Kütahya (n=4), İstanbul (n=17), Gaziantep (n=12), Çanakkale (n=3), Malatya (n=8), Muğla (n=4), and Mersin (n=2), with the numbers indicating how many agreed to be interviewed. The data were collected from 138 volunteer foster parents living in Turkey, using face-to-face interviews through an online medium between July 1 and July 30, 2020.

Participants and inclusion/exclusion criteria: Inclusion criteria were set at being at least 25 years old and having been a foster parent for at least six months.

Measures

The data were collected through a questionnaire and the Need Satisfaction Scale.

Questionnaire Form

A form prepared by the researchers consisted of eight closed-ended questions on sociodemographic characteristics (gender, age, education, marital status, and employment status) and five further questions on the foster parents' characteristics (biological child presence, age at the time of becoming a foster parent, gender of the child fostered, age of the child fostered, foster parent duration). In addition, eight closed-ended questions (factors in decision, difficulties experienced before the process, positive experiences after becoming a foster parent, negative experiences after becoming a foster parent, point of realization that the child had a psychological problem, the solution, situations that upset/disturbed them during the process, and situations in which one felt incompetent as a foster parent) investigated the parents' experiences in becoming/being a foster family. These questions were established through a review of the relevant literature (Bilican Gökkaya, 2014; Daşbaş, 2015; Goemans, van Geel, & Vedder, 2018; Tezel, Demirel & Şahin Kaya, 2018; Erdugan, 2019; Gökdoğan Şahin, 2019; Yıldırımalp & Hız, 2020).

Basic Psychological Need Satisfaction Scale (BPNSS)

The BPNSS was developed by Deci and Ryan (1991) and translated/adapted to Turkish by Bacanlı and Cihangir Çankaya (2003). The 7-point Likert-type scale consists of 21 items and measures the individual's three basic psychological needs: autonomy (items 1, 4, 8, 11, 17, and 20), competence (items 3, 5, 10, 13, 15, and 19), and relatedness (items 2, 6, 7, 9, 12, 14, 16, 18, and 21). Autonomy is the ability to choose one's behavior and freely make a decision; competence is the ability to cope with phenomena; relatedness is the sense of belonging to the environment in which a person lives and with the people with whom one has established close relationships (Cihangir Çankaya, 2005). The range of possible scores is 21–147 for the entire scale, 7–49 for the Autonomy subscale, 6–42 for the Competence subscale, and 8–56 for the Relatedness subscale, with higher scores indicating that the individual's basic psychological needs are being satisfied (and lower scores indicating that they are not). The internal consistency coefficients of the scale are .71, .60, and .74 for the subscales and .83 in total. In the present study, the Cronbach Alpha values were .64 for Autonomy, .51 for Competence, .67 for Relatedness, and .81 overall.

Analysis

The Statistical Package for the Social Sciences (SPSS) 22.0 (Statistical Package of Social Sciences Inc.; Chicago, IL, USA) software program was used for the statistical analysis of the study. Mean, standard deviation, frequency, and percentage values were used in the study. Parametric test assumptions established that the data were suitable for normal distribution and that the group variances were equal; therefore, the Shapiro-Wilk test was applied and nonparametric tests were used, since $p<.05$. The Mann-Whitney U test was used to compare the means of two groups, and the Kruskal Wallis H test to compare the means of more than two groups. Since the group variances were not equal (homogeneity of variance: Levene test $p<.05$), Tamhane's T2 and LSD tests were applied to post hoc multiple comparisons tests. To examine the relationship between foster parents' experiences of being a foster family and their psychological need satisfaction scores, Spearman Correlation Analysis was conducted, since the data did not fit the normal distribution (Özdamar, 2015).

FINDINGS

The BPNSS overall and subscale mean scores of the foster families included in the study are provided in Table 1. The overall mean score of the BPNSS for foster families was 118.38±15.83; skewness was -.726±.029, and kurtosis was -.252±.058. The mean scores of the Autonomy, Competence, and Relatedness subscales were 33.57±5.90, 32.22±5.44, and 52.58±7.10, respectively. A review of frequency distribution revealed that the skewness value was flattened because it was below alpha 3, and kurtosis was negatively skewed–left-slanted because its value was below zero. For this reason, we concluded that the scale and its subdimensions were not in agreement with the normal distribution (Özdamar, 2015).

Table 1. Participants' Need Satisfaction Scale Points (n = 138)

Need Satisfaction Scale	Min	Max	Mean	Skewness	Kurtosis
Autonomy subscale	19	42	33.57±5.90	-.552±.029	-.589±.058
Competence subscale	17	42	32.22±5.44	-.493±.029	-.034±.058
Relatedness subscale	27	63	52.58±7.10	-.719±.029	-.020±.058
Total Scale	67	144	118.38±15.83	-.726±.029	-.252±.058

The foster parent sample was composed of 84 women (60.9%) and 54 men (39.1%) with a mean age of 48.65±9.69 years. Most foster parents (90.6%) were married, indicating that married individuals were more involved in the foster family system than single people. In terms of education, 27.5% were high school graduates and all university graduates were 39.1% among the foster parents. This showed that as the education level of an individual increased, the probability of becoming a foster parent also increased. In terms of the educational status of the families and BPNSS scores, only the Sufficiency subscale score was significant ($p<.05$). The high competence level of foster parents with postgraduate education positively affected self-awareness (Table 2).

Table 2. Need Satisfaction Scale scores by sociodemographic characteristics of participants (n=138)

Sociodemographic characteristics		Need Satisfaction Subscale			Scale Total
	n(%)	Autonomy	Competence	Relatedness	Mean±SD
Sex					
Women	84(60.9)	33.52±6.11	31.86±5.15	52.20±6.86	117.59±15.45
Men	54(39.1)	32.14±6.13	31.35±6.28	50.37±8.49	113.87±18.56
		U=1947.50,p=.161	U=2141.50, p=.579	U=2027.50, p=.292	U=2091.00, p=.440
Age in years (Mean 48.65 ± 9.69)					
25–34	12(8.7)	28.41±6.24	28.00±4.00	47.75±7.33	104.16±14.91
35–44	34(24.6)	33.85±8.89	34.32±5.76	54.76±7.45	122.94±16.95
45 or older	92(66.7)	33.26±6.02	31.16±5.34	50.76±7.28	115.18±15.97
		χ^2=6.645, p=.036*	χ^2=14.485, p=.001*	χ^2=12.607, p=.002*	χ^2=12.605, p=.002*
Marital Status					
Married	125(90.6)	32.75±6.28	31.56±5.76	51.45±7.78	115.76±17.38
Single	13(9.4)	35.23±3.98	32.69±3.79	51.76±5.26	119.69±8.61
		U=662.50, p=.273	U=710.50, p=.456	U=771.50, p=.765	U=761.00, p=.707
Highest education attained					
Primary school	26(18.8)	33.38±6.90	30.30±6.39	50.34±9.08	114.03±20.10
Secondary school	20(14.5)	35.05±5.56	32.05±3.67	53.25±6.39	120.35±12.69
High school	38(27.5)	33.47±4.96	32.34±6.07	51.63±7.59	117.44±15.69
University	38(27.5)	30.81±7.26	30.34±5.66	49.92±8.01	111.07±18.81
Master's degree	16(11.6)	33.75±3.89	34.93±3.31	54.50±3.22	123.18±7.58
		χ^2=6.059, p=.195	χ^2=9.935, p=.042*	χ^2=4.494, p=.343	χ^2=4.269, p=.371
Employment status					
Employed	65(47.1)	32.32±6.44	31.98±6.10	51.23±8.34	115.53±18.98
Housewife	29(21.0)	34.75±5.24	31.68±5.24	52.68±6.76	119.13±14.03
Retired	44(31.9)	32.79±6.12	31.18±5.12	51.06±6.90	115.04±14.96
		χ^2=2.808, p=.246	χ^2=.460, p=.794	χ^2=1.195, p=.550	χ^2=1.030, p=.598

It was found that the BPNSS scores of foster parents were well above the average; moreover, psychological need satisfaction increased with age. The autonomy, competence, and relatedness scores of foster parents—especially those within the 35–44

years age range—were relatively high. A significant difference was determined by age group in the subscale and overall scale scores of the individuals participating in the study (p<.05). In an advanced analysis, the differences between age groups and the Autonomy (Tamhane's T2 p=.001), Competence (Tamhane's T2 p=.001), Relatedness (Tamhane's T2 p=.001), and overall scores (Tamhane's T2 p=.001) were significant.

The relationships between the Autonomy subscale score and the overall score with the age at which the families became foster families were significant, as were the relationships between the Competence subscale and the overall score with the age of the fostered child. It was found that as the age of foster parents increased, their Autonomy scores also increased. This situation showed that age affected the decision to become a foster parent. It was also found that the majority (78.3%) of the children placed with a foster family were girls; 42.0% of them were 3 years old and younger, and 31.9% of them were 3–6 years old. This shows that the majority of foster parents took in girls at younger ages. The difference between the duration of being a foster parent and the BPNSS overall score was significant (p<.05), with one value (LSD, p = .028) for foster parent durations of 2–5 years and 6–10 years and another value (LSD, p=.035) for foster parent durations of 6–10 and 11–20 years (Table 3).

Table 3. Need Satisfaction Scale scores of participants by certain characteristics of foster family (n=138)

Characteristics of foster families	n(%)	Need Satisfaction Subscale			Scale Total
		Autonomy	Competence	Relatedness	Mean±SD
Biological child presence					
Yes	107(77.5)	33.26±6.17	31.88±5.93	51.72±7.72	116.87±17.46
No	31(22.5)	32.03±6.01	30.90±4.26	50.64±7.05	113.58±14.07
		U=1450.00, p=.286	U=1427.00, p=.237	U=1450.00, p=.288	U=1401.00, p=.190
Age at time of becoming a foster parent					
25–34 years	14(10.1)	28.64±5.73	29.85±4.60	48.57±7.18	107.07±15.20
35–44 years	65(47.1)	32.98±6.22	32.61±5.46	52.44±7.77	118.04±17.31
45 years or older	59(42.8)	34.01±5.75	31.05±5.85	51.11±7.33	116.18±16.07
		χ^2=7.839, p=.020*	χ^2=3.159, p=.182	χ^2=4.159, p=.125	χ^2=6.202, p=.045*
Gender of foster child in home					
Girls	108(78.3)	33.29±5.82	31.98±5.63	51.95±7.35	117.23±16.04
Boys	30(21.7)	31.86±7.14	30.53±5.41	49.80±8.20	112.20±18.94
		U=1465.50, p=.424	U=1391.50, p=.237	U=1375.50, p=.206	U=1359.00, p=.178
Age of foster child in home					
2 years or younger	58(42.0)	33.46±5.90	31.22±4.42	51.10±7.04	115.79±14.58
3–6 years	44(31.9)	30.95±6.70	30.43±6.86	50.54±8.01	111.93±11.41
7 years old or older	36(26.1)	34.69±5.17	33.88±5.08	53.25±7.72	121.83±15.35
		χ^2=8.032, p=.018	χ^2=6.759, p=.034*	χ^2=3.623, p=.163	χ^2=7.618, p=.022*
Foster parent duration					
Less than 1 year	54(39.1)	33.98±5.89	31.64±6.67	52.55±8.16	118.18±18.15
2–5 years	34(24.6)	33.17±6.02	32.23±5.15	52.08±7.10	117.50±15.87
6–10 years	23(16.7)	29.78±6.84	28.78±4.11	49.04±8.18	107.60±15.84
11–20 years	27(19.6)	33.48±5.53	33.44±3.95	50.66±6.00	117.59±14.19
		χ^2=7.032, p=.071	χ^2=10.953, p=.012	χ^2=5.533, p=.137	χ^2=8.105, **p**=.044*

Abbreviation: SD, Standard deviation; U, Mann-Whitney U test; χ^2, Kruskal Wallis H test.
*p < .05

Table 4 shows the relationships between various situations experienced as a foster parent and the BPNSS scores. For deciding to become a foster parent, there was a statistically significant positive relationship between the existence of foster parent acquaintances and Autonomy, Competence, and Relatedness subscale scores and between promotional seminars and Competence subscale score. A review of the preliminary difficulties of being a foster parent showed that there was a significant positive relationship between facing bureaucratic obstacles and Competence subscale score, as well as a significant negative relationship between not facing any bureaucratic obstacles at all and Competence subscale score. As for situations where families thought that they were incompetent as foster parents, there was a significant negative significance relationship between the consideration that they were physically and socially incompetent and Autonomy subscale score (p<.05).

Table 4. The relationship between some situations in participants' foster family process and Need Satisfaction Scale scores (n = 138)

Some situations as experienced in participants' foster family process	n(%)#	Need Satisfaction Subscale					
		Autonomy		Competence		Relatedness	
		r	p	r	P	r	p
Factors in making decision							
Orphanage/dorm visits	77(55.8)	-.055	.525	.041	.635	.001	.995
Foster parent acquaintance	56(40.6)	183.3*	**.032**	264**	**.002**	.273**	**.001**
Promotional seminars	43(31.2)	.144	.091	.235**	**.006**	.293**	.001

Failure to meet the adoption conditions	28(20.3)	-.146	.087	-.031	.718	.036	.677
Difficulties experienced before the process							
Difficulty in persuading the spouse	12(8.7)	.060	.488	.047	.582	.064	.454
Encountering bureaucratic obstacles	43(31.2)	.017	.846	.204*	**.016**	.041	.637
None	93(67.4)	.008	.922	-.167	**.050**	-.011	.894
Positive experiences after becoming a foster parent							
Maturation	86(62.3)	-.064	.455	-.021	.803	-.006	.941
Being a good role model	107(77.5)	-.054	.533	.077	.370	.016	.849
Increased social status	49(35.5)	.074	.391	.059	.489	.150	.080
Negative experiences after becoming a foster parent							
Physical overtiredness	14(10.1)	.004	.966	.004	.966	.024	.781
Psychological exhaustion	20(14.5)	-.040	.638	-.042	.632	-.076	.377
Occasional regrets	5(3.6)	-.161	.060	-.047	.586	-.071	.410
Solution taken when realized that child had a psychological problem							
Getting support from a psychologist/psychiatrist	115(83.3)	-.104	.224	.027	.752	.092	.282
Getting support from social care specialists	60(43.5)	-.023	.789	-.158	.064	-.144	.092
Getting support from foster families	37(26.8)	.093	.280	.006	.948	.023	.785
Situations that upset/disturbed them during the process							
The idea of returning the child to the biological parent	77(55.8)	.023	.789	-.090	.295	.053	.536
Longer adjustment process	40(29.0)	.040	.645	.128	.136	.099	.249
Having a psychological or physical condition that cannot be resolved	64(46.6)	.084	.329	.117	.173	.064	.456
The thought of an inability to provide a good education	60(43.5)	-.006	.949	-.081	.343	-.032	.707
Situations in which one felt incompetent as a foster parent							
Physical incompetence	15(10.9)	-.194*	**.023**	-.018	.833	-.077	.368
Emotional incompetence	32(23.2)	.047	.587	.006	.944	-.075	.383
Social incompetence	24(17.4)	-.211*	**.013**	-.144	.091	-.144	.092
Economic incompetence	21(15.2)	-.129	.130	-.041	.630	-.115	.178

DISCUSSION

Like all living things, every human has their own unique needs. Individual needs may be of a biological, social, or psychological origin. For a person to live healthily, not only biological but also psychological needs must be met (Nigar, 2014). We argue that the three basic psychological needs are autonomy, competence, and relatedness (Ryan & Deci, 2000). Satisfying these needs is necessary for individuals to grow, integrate, and develop as well as to improve their mental health and well-being (Andersen, 2000); while meeting these needs creates satisfaction and happiness in an individual, not meeting them leads to pain and misery. The individual who cannot meet their needs is not only unhappy but also unable to contribute to their environment and society (Yasul, 2016).

Relevant studies (Reis et al., 2000; Sheldon & Elliot, 1999) have suggested that as the level of daily satisfaction of an individual's psychological needs increases, their positive emotions increase and their psychosomatic problems and negative emotions decrease. In their research on university students, İlhan and Özbay (2010) found that individuals who satisfied their psychological needs had higher levels of subjective well-being. Kulamber Demirci (2019) observed that an increase in psychological need satisfaction in married individuals led to a great increase in subjective well-being.

In the present study, which aimed to determine the psychological need satisfaction levels of foster families, it was found that the overall and subscale need satisfaction scores of the families were high. This finding suggests that individuals who choose to become foster parents enjoy higher levels of autonomous and competent satisfaction of psychological needs and are good at human relationships; thus, they tend toward becoming foster parents. This can be particularly important in terms of raising healthy future generations. Certain characteristics of those who gravitate toward the foster family system may cause them to become foster parents. In previous studies, it has been determined that foster parents' empathy skills and altruistic behaviors are advanced and good-tempered, compromising characteristics are dominant as their personality traits (Yeşilkayalı, 2015; Vural et al., 2016; Taşdemir Yiğitoğlu, Kıray Vural & Körükçü, 2020). It is suggested that foster parents' higher psychological need satisfaction, empathy skills, altruistic behavior, and agreeable personality are very important features in communication and in helping the child.

Satisfying individuals' basic psychological needs increases their subjective well-being levels (Ryan & Deci, 2001). Eryılmaz and Ercan's (2011) study determined that the subjective well-being of individuals increased as their age increased. In an examination

of the relationship between psychological need satisfaction and quality of life and mental well-being in adults, Bilir (2017) suggested that age influenced the satisfaction of psychological needs. Consistent with these findings in the extant literature, the present study concluded that age was significant in overall and subscale scores: as individuals get older, they can be more autonomous, more successful, and more positive in communicating with those around them. Thus, these people can become individuals who can independenly make a free choice, who are more skilled in decision-making, who are well-adjusted, who have developed the ability to understand others, and who believe that they will be successful in their work. It is estimated that as the age of foster parents increases, their BPNSS overall and subscale scores become more significant.

In this study, significance was observed between the Autonomy subscale and overall scores and the age of the foster parents, and these scores increased as the foster parent age increased. Autonomy means that one makes and maintains one's own choices and experiences (Çıkrıkçı, 2015) and manages and maintain one's attitudes and behaviors through inner motivation. The need for an individual to be autonomous involves experiencing a sense of independence and responsibility while acting in line with one's goals. In this sense, autonomy includes all aspects of the person. It can be seen that individuals who are more autonomous experience less negativity and stress. People with a high sense of autonomy are more determined in their starting and ending behaviors because of their motivation and internality. Such people tend to be independent, work individually, choose jobs where they can express themselves, resist social pressures, and dislike situations that lead to such pressures (Özen, 2016).

It has been determined that the average age for foster parenting coincides with the middle age period (Ciarrochi, Randle, Miller and Dolnicar, 2012; Yeşilkayalı, 2015; Koc, 2016; Baysal, 2017; Yıldırımalp and Hız, 2020). As individuals age, they are more aware and conscious of what they want and act autonomously in this direction, which suggests that this correlation is expected.

In the present study, significance was found between the level of education and the Competence subscale score, although with the Autonomy and Relatedness subscale scores. The mean Competence score was found to be higher in those with a post-graduate level of education. Competence is the awareness of one's abilities and strengths, found by combining cognitive, social, emotional, and behavioral elements. The individual's attitudes and behaviors are a result of being aware of their competence to achieve their goals. Competence is an important factor for individuals to cope with difficulties in their lives and to reach their goals. The need for competence, together with individuals' desire to influence their environment, qualifies as a guide for situations in which individuals can have positive relationships with their environment, use their capacities at the highest level, and overcome issues (Çıkrıkçı, 2015). The individual experiences a process of development and learning throughout their life. Often, a situation stops being enough after a while, so the individual starts the process of learning something new. Individuals with a high sense of competence reach their goals more quickly and experience more satisfaction (Özer, 2009).

In this study, the high Competency subscale of foster families with post-graduate education suggests that education affects an individual's level of awareness of their abilities and strength.

This study determined that gender did not influence individual satisfaction of psychological needs. The literature includes studies with different findings on the relationship between the satisfaction of psychological needs and the variable of gender. While some research concludes that the satisfaction of needs does not differ by gender (Eratay, Sarı & Kermen, 2010; Gündoğdu & Yavuzer, 2012; Sarı, Yenigün, Altıncı & Öztürk, 2011; Eryılmaz and Ercan 2011; Nigar, 2014; Bilir, 2017), other studies suggest the opposite (Hamurcu, 2011; Toprak, 2014; Küçü, 2018). Cihangir Çankaya (2009) suggested that while there was no significant difference between the genders in terms of autonomy and competence need satisfaction, there was a significant difference in favor of women in terms of relatedness. Moreover, a significant relationship was found between gender and empathy, altruistic behavior, and personality traits of foster parents (Yeşilkayalı, 2015; Vural et al., 2016; Taşdemir Yiğitoğlu, Kıray Vural & Körükçü, 2020). Based on the knowledge that physiological, social, and psychological needs are universal for each individual (Nigar, 2014), we can say that gender is not expected to affect the level of psychological need satisfaction.

Previous studies have found different results regarding marital status and employment status. Some studies found that marital status had no influence on need satisfaction (Eryılmaz & Ercan, 2011; Nigar, 2014; Bilir, 2017), while others found the opposite (Carr et al. 2014; Washworth, 2016). This study found that marital status and employment status did not influence the levels of need satisfaction.

One of the factors in deciding to be a foster parent is the presence of acquaintances who are foster families. A positive relationship was found between the presence of acquaintances who are foster families and Autonomy, Competence, and Relatedness subscale scores. In other words, it indicates that individuals discussing this subject with acquaintances is influential on people making autonomous decisions by allowing them to prepare themselves and feel competent. Another factor in making decisions on foster parenting is promotional seminars: a relationship between 'promotional seminars' and Competence subscale score means that relevant education makes the individual feel competent about this subject. A list of the reasons that motivated families to decide to become foster parents included having a child, helping someone, having an acquaintance foster parent, and attending seminars on foster family. These findings are consistent with our study (Bilican Gökkaya 2014; Tezel et al., 2018, Erdugan, 2019; Certel, 2019).

In this study, we observed a negative relationship between families' physical and social incompetence as foster parents and Autonomy subscale score, as well as a relationship between encountering/not encountering preliminary bureaucratic obstacles and Competence subscale score. In addition to the basic-, first-, and second-level training of foster families, preparatory training

for the foster family of the children who will be placed and supportive training during the process help increase the competence of the parents (Certel, 2019).

It has been suggested in previous research that families who have had difficulties in coping with emerging problems should receive therapeutic support to increase their competence (Buehler, Rhodes, Orme and Cuddeback, 2006). Family therapy sessions, parenting attitudes, and family-based approaches that address the family and the child together are used to reduce stress and to solve the problems encountered in being a foster family (Abukan, 2020). Therapeutic interventions aimed at foster families should be coordinated by experienced professionals with a lower case workload. The interventions needed for the wider social environment (behavioral problems, communication, anxiety, stress, anger, etc.) should also be planned by professionals (Baker et al., 2007; Certel, 2019). Furthermore, foster family associations play an important role in strengthening parents' autonomy in matters such as connecting with others, sharing problems, and being informed (Certel, 2019).

CONCLUSION AND RECOMMENDATIONS

The present study concludes that the foster parents studied here had high levels of psychological need satisfaction, had established desirable human relations, and were autonomous and competent. Also the presence of a biological child, the gender of the child being fostered, and the duration of being a foster parent did not influence need satisfaction levels.

It is important to develop training programs for foster families that reflect the characteristics found in this research study. We suggest that it may be important for accredited members of the profession to determine individuals' psychological need satisfaction levels before they become a foster family and to select families according to the above criterion.

Limitations of the study

Some difficulties and limitations were encountered in this study. The first limitation of our study is the use of non-probability sampling method in sample determination method. The fact that the sample group is predominantly in Denizli province constitutes another limitation. Therefore, the study cannot be generalised to the universe.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

All authors were involved in study planning and design.
Conception and design: B.K.V.
Collected the data: B.K.V., Ö.K, G.T.Y.
Analysis and interpretation of data: B.K.V.
Drafting the article: B.K.V., Ö.K, G.T.Y.
Final approval of the version to be published: B.K.V., Ö.K, G.T.Y.
All authors approved the final version for submission.

Ethics Committee Approval Information

The study was carried out according to the principles of the Helsinki Declaration. The participants were informed about the purpose of the study, and their informed consent was obtained before data collection. Ethical approval for the study was given by the Pamukkale University Ethics Committee (approval date and ref number June 25, 2020 / 60116787-020/37913).

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Perspectives of Education Faculty Students on Creative Teacher and Creative Learning Environment

Eğitim Fakültesi Öğrencilerinin Gözünden Yaratıcı Öğretmen ve Yaratıcı Öğrenme Ortamı [1]

Canan CENGİZ[1], **Şenem ALKAN YILMAZ**[2]

Abstract

Purpose: This study aims to examine students in the field of science teaching perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

Participants consist of 1st, 2nd, 3rd, and 4th-grade 247 students in the field of science teaching who voluntarily participated in the study during the spring semester of 2021-2022 at three state universities in Turkey.

Design/Methodology/Approach: The study was designed in accordance with the qualitative research approach. In order to determine the metaphors of students, hold about the concepts of "creative science teacher" and "creative science learning environment" a form was used. In the first section of the form, respondents were asked to complete "Creative science teacher is similar to...... because......" and "Creative science learning environment is similar to...... because......." sentences. In the second part of the form, students were asked to draw the creative science learning environment and creative teacher in the science lesson. The data obtained from the forms were subjected to content analysis.

Findings: Based on the findings obtained from the study, it was determined that the students produced the most laboratory metaphors for the creative science learning environment, and the most frequently used object in their drawings was laboratory material. It was observed that the students were shown to generate the greatest number of scientists metaphors for creative science teachers and it is determined that their metaphors changed according to their grade level.

Highlights: It can be suggested to investigate the factors that cause the differences in the students' perspectives on creativity.

Öz

Çalışmanın amacı: Bu çalışmanın amacı, fen bilgisi öğretmenliği bölümünde öğrenim gören öğrencilerinin yaratıcı fen öğrenme ortamı ve yaratıcı fen öğretmenine yönelik algılarının yazılı ve görsel metaforlar aracılığı ile incelenmesidir.

Çalışmanın örneklemini 1., 2., 3. ve 4. sınıfta öğrenim gören 247 öğrenci oluşturmaktadır.

Materyal ve Yöntem: Bu çalışmada katılımcıların olayları, olguları tümevarımcı bir yaklaşımla nasıl tanımladığını ortaya çıkarmak ve bakış açılarını anlamak hedeflendiğinden çalışma nitel araştırma yaklaşımına uygun olarak yürütülmüştür. Öğrencilerin "yaratıcı fen bilgisi öğretmeni" ve "yaratıcı fen öğrenme ortamı" kavramı ile ilgili zihinlerindeki metaforları belirlemek amacıyla 'Yaratıcı Öğrenme Metaforum' olarak adlandırılan bir form geliştirilmiştir. Formun ilk bölümünde "Yaratıcı fen bilgisi öğretmeni ....'ya benzer çünkü ...." ve "Yaratıcı fen öğrenme ortamı ......'ya benzer çünkü ......" cümlelerini öğrencilerin kendi düşünceleri doğrultusunda tamamlamaları istenirken, ikinci bölümünde ise fen dersinde yaratıcı düşünme becerilerini geliştireceğini düşündükleri, yaratıcı fen öğrenme ortamını ve öğretmenini çizerek anlatmaları istenmiştir. Formlardan elde edilen veriler içerik analizine tabi tutulmuştur.

Bulgular: Çalışmadan elde edilen bulgulara dayalı olarak ise öğrencilerin yaratıcı fen öğrenme ortamına yönelik en fazla laboratuvar metaforunu ürettikleri ve çizimlerinde ise en sık yer verdikleri nesnenin laboratuvar malzemesi olduğu belirlenmiştir. Öğrencilerin yaratıcı fen bilgisi öğretmenine yönelik olarak ise en fazla bilim insanı metaforunu ürettikleri görülmüştür. Ayrıca, öğrencilerin metaforlarının sınıf seviyelerine göre farklılık gösterdiği belirlenmiştir.

Önemli Vurgular: Öğrencilerin yaratıcılığa bakış açılarındaki farklılıklara sebep olan faktörlerin araştırılması önerilebilir.

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INTRODUCTION

Today, creativity is one of the key qualities that people are expected to exhibit. Creativity can be defined as the ability to develop novel solutions to issues (Runco, 1994) and break out of existing patterns (Rıza, 2006). Curriculum and learning environments have a significant role in the development of creativity (Topoğlu, 2015). In this context, schools should equip students with creativity, innovation, and entrepreneurship skills for the future (Learning & Teaching Scotland, 2007). Therefore, countries are revising their curricula to incorporate these skills.

By its very nature, science education lends itself to inquiry, questioning, and imagination. Individuals who can use their creativity can produce innovative solutions to the problems they encounter in daily life by using the scientific knowledge they have acquired through science education (Koray, 2003). For this reason, science emerges as one of the essential learning areas that can be effective in fostering creativity (Daud, Omar, Turiman & Osman, 2012). It is known that creative thinking was incorporated into the national curriculum in 2013 (MEB, 2013). Creative thinking skill, which is included in the curriculum as one of the life skills, also takes place in the most recent curricular change made in 2024 (MEB, 2024).

Creativitiy can be taught and nurtured (Piirto, 2021). Teachers with creative personality traits have a significant impact on the growth of students' creativity (Senemoğlu, 2018). In addition, the environment in which learning takes place is another essential element that has an influence on the development of creative thinking skills. Also, a significant relationship exists between the learning environment and the learning outcome (Bland & Sharma Brymer, 2012). The development of creativity can, thus, be assisted by creative teachers who can establish a novel, engaging, and stimulating learning environments (Arrington, Moore & Bagdy, 2021; Kranyik & Bartlett, 1965).

For science teachers to cultivate creative thinking skills in their students, they must first possess creative teacher characteristics and be able to design science learning environments that can enhance students' creative thinking skills (Chan & Yuen, 2014). In this regard, Baghetto and Kaufman's (2014) study show that teachers care about fostering their students' creativity; however, they lack adequate knowledge of the methods and strategies they might employ to achieve this objective. Teachers expressed the need for specific examples on this issue. The current state of education policy and educational systems is seen to require greater efficiency in order to foster creativity (Kupers et al., 2018). For this reason, teachers need to find ways to develop creativity in their classrooms so that their students can produce creative solutions to the problems they encounter in a modern and globalized world (Aldous, 2007; Henriksen, 2018). Within this framework, in this study it is aimed to examine education faculty students (enrolled in science teaching program) perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

Creative Teacher and Creative Learning Environment

Thoughts about the concept of creativity date back to the time of Plato, and has attracted the attention of people throughout history (Maba, 2019; Yeşilyurt, 2020). There are many different definitions of creativity in the literature (Kanlı, 2014), according to Torrance (1988), the reason why the concept does not have a single definition is that it is largely unseen, nonverbal, and unconscious. Also, the belief that creativity is a feature that only gifted people can have has caused the development of this concept to take many years (Yeşilyurt, 2020). But today it is accepted that creativity can be improved through education (Ritter, Gu, Crijns, & Biekens, 2020). Boden (2001, p. 95) define creativity as one's "ability to come up with new ideas that are surprising yet intelligible, and also valuable in some way". Although creativity and creative thinking were initially associated only with art, in later years they also came to the fore in fields such as economy, technology and education (Koray, 2005).

According to Sternberg, Grigorenko and Singer (2004), despite individual differences, the experiences and opportunities individuals have throughout their lives affect the development of creativity. Learning environments in the educational process appear as an important factor in supporting creativity (Kaufman & Baghetto, 2014). A creativitiy supported environment allow individuals to engage and enjoy a learning activity. In such an environment, students will likely be able to develop their skills by exerting greater effort (Richardson & Mishra, 2018) and have the opportunity to practice their skills (Lerang et al., 2019).

Adapting creativity to the classroom environment is a multifaceted and complex process (Jeffrey & Craft, 2004) due to students' different interests, beliefs, abilities, and prior knowledge. For this reason, it is essential to create learning environments that consider individual differences (Kılıç, Yavuz Konokman & Yanpar Yelken, 2018). Therefore, learning environments that are student-centered and employ diverse ways of thinking (Kılıç, Yavuz Konokman &Yanpar Yelken, 2018), consider individuals' developmental characteristics, take cognizance of their decisions, direct them (Yenilmez &Yolcu, 2007), and provide various options (Fleith, 2000) are effective in improving the creativity of individuals. In addition, environments rich in engaging stimuli contain different objects, advanced technology, libraries, and various data and data sources that keep the curiosity of individuals alive (Peterson, 2002).

Teachers need to have several qualities in order to help their students become more creative. Creative teachers have developed imaginations, are prone to problem solving, and are willing to create different learning environments that meet students' expectations by bringing different ideas to the classroom environment. Creative teachers, who see each student as a unique individual, support students to express their thoughts freely and serve as good role models for them (Chambers, 1973; Onur & Zorlu, 2018; Schreglmann & Kazancı, 2016). According to Schreglmann and Kazancı (2016), a creative teacher should be able to provide solutions to problems, organize educational environments according to students' expectations, and provide a

stimulating and engaging learning environment for students. Piirto (2021) discussed the duties of teachers in creating a creative learning environment. These are summarized below:

It is important for teachers to know the characteristics of her students especially their strengths. This will led teacher to plan her lessons taking into account individual differences and help their students to recognize self-awareness. It's also critical to encourage students to take risks, to learn from their mistakes and to showcase their creativity. The way to do this is to create an environment of trust in the classroom. So, students feel at ease asking questions of one another. Teachers should be proficient in methods like mindfulness, meditation, slowing down, and paying attention. Also, teachers should enriched learning environments athletics, foreign languages, dance, theater, music, and art are essentials. Another thing, self-knowledge resources like nature walks, labyrinth walks, meditations, and mandalas can inspire and provide students with insight. Furthermore, education outside the school like field trips to museums also supports creative thinking.

Hadzigeorgiou, Fokialis and Kabouropoulou (2012) determined the features of creative science activities and suggested several activities for creative science:

- Primerly understanding the subject matter of science is necessary for thinking, and thus for creative thinking.
- Divergent and innovative thinking are key components of creativity in science education.
- Promoting the creation of ideas in a safe and criticism-free setting is important
- Curriculum and teaching in science should place a strong emphasis on imagery and visualization.

Taking these features into consideration, creative problem solving, problem solving in science, technology and society context, creative writing, creative science inquiry, creating analogies to understand phenomena and ideas, challenging students to find connections among apparently unrelated facts and ideas, approaching the teaching and learning of science through the arts can be suggested.

This study aims to examine students' perspectives of creative science teachers and creative science learning environments that will improve students' creative thinking skills and creativity through written and visual metaphors.

METHOD/MATERIALS

Since this study aims to explore how the participants describe events and phenomena with an inductive approach and to understand their perspectives (Yücel Cengiz & Ekici, 2020), the study was designed in accordance with the qualitative research approach.

Participants

Participants consist of 1st, 2nd, 3rd, and 4th-grade education faculty students* who voluntarily participated in the study during the spring semester of 2021-2022 at three state universities in Black Sea Region of Turkey (*students are enrolled in the science teaching program and expressed as "student" in the following sections of the study). In this context, a total of 247 students participated in the study. The distributions regarding the universities and grade levels of the students are given in Table 1.

Table 1. The Universities and Grade Levels of the Students

Variable		Frequency (f)
University	Grade Level	
	1st grade	20
A University	2nd grade	28
	3rd grade	18
	4th grade	31
	1st grade	35
B University	2nd grade	28
	3rd grade	17
	4th grade	10
	1st grade	27
C University	2nd grade	21
	3rd grade	6

	4th grade	6
	Total	247

Table 1 shows that 82 students participating in the study are in the 1st grade, 77 in the 2nd grade, 41 in the 3rd grade and 47 in the 4th grade.

Data Collection Tool

The study's data consists of metaphors and drawings created by students. Metaphors are tools that reveal how individuals interpret events, situations, and thoughts (Cerit, 2008). Drawings, like metaphors, allow individuals to reflect on their feelings and thoughts (Barrantes Elizondo, 2019) and convey their ideas in situations where they cannot be expressed via words. (Cengiz & Ekici, 2019). For these reasons, these two sources were used together as a data collection tool in this study.

Researchers developed a form titled "Creative Learning Metaphor" in order to determine the metaphors of students hold about the concepts of "creative science teacher" and "creative science learning environment." Examining the current research in the literature served as the basis for the development of the form, which was then refined with the advice of two researchers who are experts in the field of science education. In the first section of the form, respondents were asked to complete the following sentences based on their ideas: "Creative science teacher is similar to...... because......" and "Creative science learning environment is similar to...... because.......". Before using form as data collection tool, it was first conducted to eight students from all grade levels, thus trying to determine the understandability of the form. It was determined that students completed the form within 15-20 minutes without any problems.

Analysis of Data

Before beginning the data analysis, the forms filled out by students were numbered from 1 through 247. Then, the data gathered from the forms was contextually analysed (Lichtman, 2010). The phases of the analysis procedure are detailed below (Ekici, 2016a; Saban, 2008).

1. Metaphors developed by students were listed, and a list was created for this purpose.
2. The distribution categories for the metaphors provided by students were identified. The "because..." section, in which students explain the rationale behind the metaphors they created, was considered for identifying these categories.
3. The listed metaphors were distributed into appropriate categories.
4. During the analysis of the students' drawings, each object, situation, and shape was identified. Each object was counted and the frequency of its inclusion in the drawings was given.

Ensuring Validity and Reliability

The following procedures were carried out to ensure the validity and reliability of the study (Hruschka et al., 2004; Miles & Huberman, 1994; Ratcliff, 1995; Yıldırım & Şimşek, 2016).

• Data analysis and data collection process are explained in detail in the process of listing the metaphors, creating the appropriate categories, and distributing the metaphors to these categories.

• Examples of metaphors and explanations created by students are given in the findings section of the study.

• Attempts were made to determine the similarities and differences between this study and previous research on this issue.

In order to ensure the reliability of the study, the compatibility between the coders was examined. 15% of the papers were coded independently by two researchers for the metaphors. The percentage of agreement between the coders was calculated using the formula Reliability=Number of agreements/(number of agreements+number of disagreements)*100 developed by Miles and Huberman (1994). Coherence between coders was calculated as 92% for metaphors. The fact that agreement across coders is at least 90% demonstrates that the study's reliability can be reached (Miles & Huberman, 1994). For the drawings, one of the researchers who conducted the study created the categories. Then, the other researcher examined the drawings included in the categories, the differences of opinion were discussed among the researchers, and a consensus was reached.

FINDINGS

The findings obtained from the study were examined under two headings: the metaphors developed for the creative science learning environment and their distribution according to categories, and the drawing examples related to the creative science learning environment and their distribution according to categories.

Creative Teacher and Creative Learning Environment

Students' metaphors and explanations for the creative science learning environment were evaluated together. This way, a total of 98 metaphors created by students were gathered under seven categories. These categories were "versatile, limitless,

observable, exploratory, entertaining, intertwined with nature, and need-based". Next, relevant categories and metaphors were gathered under these categories, and their frequencies were tabulated. An example of the "entertaining" category is given in Table 2.

Table 2. Metaphors of the Entertaining Category

Category	Class	Metaphors	f
Entertaining	1	Game room (2), circus show (1), leisure (1), playground (1), funfair (1), entertainment area (1)	7
	2	Amusement park (3), play dough (1), house (1), playground (1)	6
	3	Amusement park (5), picnic area (1), ball pool (1), carnival (1), drama hall (1), playground (1)	10
	4	Amusement park (2), stage (1), wonderland (1)	4

The metaphors created by the students for the creative science learning environment, such as the amusement park, game room, playground, picnic area, carnival, and drama hall were gathered under the fun category. The statements of the students show that they think creativity can develop in an entertaining environment. For example, S193 described the creative science learning environment with the "circus show" metaphor and explained, "I think a creative science learning environment is similar to a circus show. Because similar to a circus show, experiments bring creativity to the forefront in a wide variety of areas."

Versatile

The metaphors created by the students for the creative science learning environment, such as the puzzle, factory, ecosystem, discovery island, botanical garden, earth, sky, nature, universe, multi-program machine, library, rainbow, and forest metaphors were categorized as versatile. In their explanations, the students who stated these metaphors asserted that the creative science learning environment has distinctive features. For example, S236 described the creative science learning environment with the metaphor of "sun" by stating, "I think creative science learning environment is similar to the sun. Because it has a feature that excels in all subject areas and enlightens students by revealing novel concepts."

Limitless

The students' metaphors for the creative science learning environment, such as the universe, sun, space, laboratory, nature, sky, earth, and ocean, were grouped under the category of the creative science learning environment without limits. Students consider a creative learning environment to be one that encourages learner autonomy and empowers students to use their creativity. For this reason, these metaphors are grouped under the category of limitless. For example, S109 described the creative science learning environment with the metaphor of "space" and said, "I think creative science learning environment is similar to space. Because space is limitless and open to everything, there should be an endless supply of information and a limitless world of ideas."

Observable

Under the category of observability of the creative science learning environment, students' metaphors such as laboratory, theater, abstract object, real life, scales, factory, science center, light, zoo, nature, world, sky, science-related goods, movie theater, and stage were compiled. In this regard, students explained that abstract knowledge should be made concrete in a creative science learning environment. For this reason, similar metaphors were grouped under the observable category. For example, S44 described the creative science learning environment with the metaphor of "nature" and said, "I think creative science learning environment is similar to nature. Because we observe everything in nature better, they are the regions accessible for observation and examination at any time. Science is life itself."

Exploratory

The metaphors created by the students for the creative science learning environment such as laboratory, experimental setting, fair, campground, playground, world, the place where we can feel great emotions from small things, school, the room where secret potions are made, space, puzzle, museum, science center, experiment table, inventing, factory, place of scientific research, shooting star from the sky, an island full of impossibilities, garden, planet, forest, all environments, play dough and nature were gathered under the category of the exploratory science learning environment. Students believed that the creative science learning environment would allow them to develop a new product or concept as a result of the activities and experiments to be conducted. For this reason, these and similar metaphors are grouped under the exploratory category. In this regard, S58 described the creative science learning environment with the metaphor of "factory" and said, "I think the creative science learning environment is similar to a factory. Because, just as machines work to make a product in a factory, students work in a science learning environment to develop and discover something."

Nature

The metaphors of the students for the creative science learning environment such as nature, garden of the house, forest, world, laboratory, events in nature were gathered under the category of creative science learning environment intertwined with nature. Especially those students who stated that nature is the basis of science and creativity and that the events taking place in

nature can be explained by combining science and creativity together, frequently produced metaphors such as nature and forest. These and similar metaphors were grouped under the category of intertwined with nature. On this basis, S134 described the creative science learning environment with the metaphor of "events in nature" and stated, "I think a creative science learning environment is similar to the events that take place in nature. Because there are numerous scientific events in nature. Science simply explains how it rains, how birds fly, and how plants make their own food".

Needs-based

The students' metaphors for the creative science learning environment, such as the library, technology, nature, the building's foundation, the environment with science-related goods, the cloud, the computer, and the stationery environment, were categorized under the needs-based creative science learning environment. In general, students characterized the creative science learning environment as one that provides them with all the materials, tools, and instruments necessary to develop their creativity. For this reason, these and similar metaphors were grouped under the category of needs-based. For example, S19 described the creative science learning environment with the metaphor of a "stationery environment" and said, "I think the creative science learning environment is similar to the stationery environment. Because the students should have access to the materials they need at that time and be able to learn with the materials they choose."

Figure 1 presents the word cloud containing the metaphors created by the students for the creative science learning environment.

Figure 1. Metaphors Related to the Creative Science Learning Environment

Examining Figure 1 reveals that students create the most "laboratory" metaphor for the creative science learning environment. Then came the metaphors such as an amusement park, a forest, space, nature, etc. The three categories containing the most metaphors are provided in Table 3 based on the number of metaphors collected for each category.

Table 3. Categories Containing the most Metaphors by Grade Levels

Grade Level	G1	*f	G2	f	G3	f	G4	f
	Exploratory	16	Exploratory	20	Versatile	15	Versatile	16
Category	Versatile	15	Observable	13	Entertaining	10	Limitless	6
	Observable	13	Versatile	12	Limitless	4	Exploratory	5

*number of metaphors collected under the relevant category

As shown in Table 3, most of the metaphors created by first and second-graders fell into exploratory, versatile, and observable categories. The first and second graders described the creative learning environment as more like an "exploratory" environment. On the other hand, it has been observed that third- and fourth-grade students often describe the creative science learning environment as "versatile". Unlike the first and second graders, students in the third grade produced metaphors that could be grouped under "entertaining" and "limitless" categories. In contrast to students in the first and second grades, individuals in the fourth grade also developed metaphors that could be classified as "limitless". Finally, unlike the third and fourth grades, the creative learning environment is described as "observable" in the first and second grades.

In Figure 2, the objects utilized by students in their drawings of a creative science learning environment are presented as a word cloud.

Figure 2. Objects Related to the Creative Science Learning Environment

When Figure 2 is examined, it has been determined that the most frequently used object in the drawings of the students regarding the creative science learning environment is laboratory materials. The laboratory materials are followed by drawings for the seating arrangement, nature/forest, and experimentation.

Table 4. Objects Included in the Drawings Related to the Creative Science Learning Environment

Grade Level	Drawing	f	Drawing	*f
1st Grade	Laboratory materials	34	Technological tools	4
	Nature/forest	20	3D material	2
	Experimentation	16	Beach	1
	Seating arrangement	5	Space	1
			Botanic garden	1
			Universe	1
			Library	1
			Poster	1
2nd Grade	Laboratory materials	30	Poster	4
	Seating arrangement	23	Theatre	2
	Technological tools	14	Space	2
	Experimentation	11	Fun fair	2
	3D material	11	Research office	1
	Nature/forest	9	Zoo	1
	Library	8	Park	1
			City	1
			Team work	1
			Virtual reality	1

Grade	Object	f	Object	f
3rd Grade	Seating arrangement	13	Technological tools	4
	Laboratory materials	12	Nature/forest	4
	Library	5	3D material	4
			Playground	2
			Experimentation	2
			Schoolyard	1
			Poster	1
			Space	1
			Team work	1
			Fun fair	1
4th Grade	Nature/forest	14	Theatre scene	4
	Experimentation	12	Library	3
	Laboratory materials	12	Submarine	1
	Seating arrangement	8	Science Center	1
	Technological tools	7	Ocean	1
	3D material	6	Beach side	1
			Station technique	1

f frequency: 5 and more than 5 *f frequency less than 5

In Table 4, the objects and their frequencies in the drawings of the students regarding the creative science learning environment are given. As seen in the table, the objects that appeared most frequently in the drawings of students in the first and second grades were laboratory materials, whereas these objects ranked second and third in the drawings of third and fourth-grade students. In addition, while the seating arrangement is the most frequently used drawing in the third grade, nature/forest drawings are the most common in the fourth grade.

Creative Teacher: Metaphors

Students' metaphors and explanations for the creative teacher were evaluated together. A total of 122 metaphors created in this direction were gathered under ten categories. These categories were determined as versatile, remarkable, limitless knowledge, individual differences, innovative, guide, elaborative, process management, curious, and exploratory. Relevant categories, metaphors gathered under these categories, and their frequencies are tabulated. An example of the "guide" category is given in Table 5.

Table 5. Metaphors of the Guide Category

Category	Grade	Metaphors	f
Guide	1	Nature (3), sunlight (3), tree (1), sun (1), ship captain (1), candle (1), compass (1), rose (1), library (1), seed (1), tree roots (1), air (1), iron (1), guide (1)	18
	2	Sun (4), compass (2), pole star (1), moon (1), mirror (1), Superman (1), internet (1), light (1), key (1), torch (1), candle (1), guiding light (1), guide (1), imagination (1)	18
	3	Entrepreneur (1), earth (1), light (1), compass (1), play dough (1), pilot (1)	6
	4	Leader (1), computer (1), mentor (1), painter (1), chameleon (1), key (1), mother (1), candle (1)	8

Regarding the characteristics of the creative science teacher, the metaphors that students used such as nature, sunlight, tree, sun, ship captain, candle, compass, rose, library, seed, tree roots, air, iron, guide, pole star, moon, mirror, superman, internet, light, key, torch, guiding light, guide, imagination, entrepreneur, earth, play dough, pilot, leader, computer, guide, painter, chameleon, and mother were gathered under the category of the creative science teacher as a guide. The students stated that creative teachers should lead and direct their students and serve as a guide for every learning situation the students may encounter. For this reason, these metaphors are grouped under the category of the guide. S36 described the creative science

teacher with the metaphor of the "pole star" and said, "I think a creative science teacher is similar to a pole star. Because our guide when we are confused about a topic is the teacher".

Versatile

Regarding the characteristics of the creative science teacher, metaphors such as the brain, wrench, tree branches, captain, solar system, rainbow, oxygen, puzzle, matryoshka, tree, scientist, pencil, space, ocean, colored beads, colors, factory, sun, and computer were collected under the category of the creative science teacher as a versatile person. In their explanations, students asserted that a creative teacher must possess various skills and knowledge of numerous subjects. For this reason, these and similar metaphors are grouped under the category of versatile. For example, S35 described the creative science teacher with the metaphor of "ocean" and said, "I think a creative science teacher is similar to the ocean. Because it is creative, it is as vast as the ocean and diverse in many ways".

Remarkable

Regarding the characteristics of the creative science teacher, metaphors such as the clown, buffoon, scientist, physics teacher, intelligence cube, painter, cartoon, magic, surprise box, magician, theater artist, magic box, star, fun day, Disney character, entertainer, rainbow were collected under the category of the creative science teacher as a remarkable person. These and similar metaphors were classified under the remarkable category since students claimed in their explanations that a creative teacher should grab attention in every context, provide variety in the learning environment, and leave students wondering. In that respect, S74 described the creative science teacher with the metaphor of a "star" and said, "I think a creative science teacher is similar to a star. Because a creative teacher grabs the student's attention and keeps them focused".

Limitless knowledge

Regarding the characteristics of the creative science teacher, metaphors such as the book, pen, light, intellectual, philosopher, software developer, treasure, scientist, space, sun, Rick, the lead role in the series, internet, naturalist, astronaut, forest protector, library, inventor, teacher, the computer, universe, science literate and sky were collected under the category of the creative science teacher as a person having limitless knowledge. Since the students stated in their explanations that the creative teacher should be able to provide sufficient responses to all students' questions and that the teacher should have the answer to each question they sought, these and similar metaphors were categorized as limitless knowledge. In this vein, S82 described the creative science teacher with the metaphor of "intellectual" and said, "I think a creative science teacher is similar to an intellectual. Because his knowledge encompasses all branches of science, he can enlighten people on any issue".

Individual Differences

Regarding the characteristics of the creative science teacher, metaphors such as knowledge, rainbow, earth, clown, tree, and scientist were collected under the category of the creative science teacher as a person paying attention to individual differences. These and similar metaphors were grouped under the category of individual differences because students stated that a creative teacher should consider the characteristics of all students and, if the student's characteristics differ, they should plan the entire instructional process accordingly. In this context, S108 described the creative science teacher with the metaphor of a "rainbow" and said, "I think a creative science teacher is similar to a rainbow. Because each student's learning style is unique, their approach to learning will be different. So, each color of the rainbow represents a distinct strategy".

Innovator

Regarding the characteristics of the creative science teacher, metaphors of the magician, researcher, original individual, idol, dreamer, scientist, space, book, pencil, comedian, cube, miracle, tree, engineer, imagination, computer, scholar, matryoshka, factory, speed of light, nature, painter, newsletter, ant, seed, and theater actor were collected under the category of the creative science teacher as an innovator. The students stated that creative teachers should be able to come up with new ideas and products and encourage their students to do so. For this reason, these and similar metaphors are grouped under the innovator category. S83 described the creative science teacher with the metaphor of "researcher" and said, "I think a creative science teacher is similar to a researcher. Because he/she constantly seeks to add new knowledge to his/her existing store and he/she is innovative".

Elaborative

Regarding the characteristics of the creative science teacher, metaphors of the filter, scientist, microphone, photographer, painter, and the one who prepares an experimental environment for the students with the materials they have in every condition, were collected under the category of the creative science teacher as an elaborative person. The students stated that the creative teacher should give importance to details and that it is necessary to pay attention to the details to reveal creativity. For this reason, these and similar metaphors are grouped under the category of elaborative. As an illustration, S5 described the creative science teacher with the metaphor of a "painter" and said, "I think a creative science teacher is similar to a painter. Because, similarly to how a painter focuses on the nuances of natural elements in each painting, a science teacher addresses each material and event in nature in each lesson".

Process management

Regarding the characteristics of the creative science teacher, metaphors of heart, time, ocean, world, comedian, scientist, superhero, and freedom were collected under the creative science teacher's process management category. These and similar metaphors were classified under the category of process management, as students claimed that a creative teacher should manage time effectively and be able to control the entire process when planning the lesson. As for example, S6 described the creative science teacher with the metaphor of a "comedian" and said, "I think a creative science teacher is similar to a comedian. Because he uses the time given to him most effectively and efficiently".

Curious

Regarding the characteristics of the creative science teacher, metaphors of scientist, hero, clown, and surprise gift were collected under the category of the creative science teacher as a curious person. Since students emphasized that curiosity is a prerequisite for creativity, they asserted that a creative teacher also needs to be curious. For this reason, these and similar metaphors are grouped under the curious category. S192 described the creative science teacher with the metaphor of "scientist" and said, "I think a creative science teacher is similar to a scientist. Because, observantly and inquisitively, s/he conducts investigations that have never been done before".

Explorer

Regarding the characteristics of the creative science teacher, metaphors of scientist, young child, researcher, inventor, computer, magician, ant, worker bee, wanderer, and laboratory, were gathered under the category of the creative science teacher as an explorer. These and similar metaphors were grouped under the explorer category, as students stated that the creative teacher should give importance to discovery and that they should allow their students to explore in this context. S238 described the creative science teacher with the metaphor of a "traveler" and said, "I think a creative science teacher is similar to a traveler. Because creativity enables people to find and acquire new information continuously. A teacher with a creative way of thinking learns through exploring like a traveler."

The metaphors students have developed for the creative science teacher are presented in Figure 3 as a word cloud.

Figure 3. Characteristics of the Creative Science Teacher

Figure 3 shows that "scientist" was the metaphor students created the most for the creative science teacher. The rainbow, sun, and nature metaphors followed this.

As a result of combining the metaphors under each category, the three categories with the most metaphors are presented in Table 6.

Table 6. Categories Containing the most Metaphors by grade Levels

Grade Level	G1	*f	G2	f	G3	f	G4	f
	Guide	18	Guide	18	Versatile	10	Remarkable	10
Category	Versatile	14	Limitless knowledge	12	Limitless knowledge	7	Innovative	10
	Limitless knowledge	14	Innovative	11	Guide	6	Guide	8

*the number of metaphors collected under the relevant category

As can be seen in Table 6, the metaphors produced by the first and second-grade students were gathered in the categories of guide, versatile, innovative, and limitless knowledge. The creative teacher was described as more of a guide by students in the first and second grades; on the other hand, it is seen that third-grade students generally describe the creative teacher as versatile. In the fourth grade, students characterized the creative teacher as remarkable and innovative. According to an analysis of all grade levels, the guide category is one of the three most frequently repeated categories across all grade levels.

DISCUSSION

The findings obtained from the study revealed that students use a variety of metaphors to describe the creative learning environment. When the metaphors are grouped, it is seen that the learning environment is generally described as an environment that is versatile and suitable for exploration. When the literature is examined, evidence regarding the necessity of a versatile learning environment is located. Fleith (2000) states that environments that support creative thinking should offer students different options and encourage them to look at things from different perspectives (Fleith, 2000). Moreover, this result is supported by the fact that creative thinking does not have a single dimension; instead, it has multiple characteristics, including fluency, flexibility, originality, and enrichment (Köksal Akyol & Salı, 2016). Some studies investigate the metaphorical perceptions of preschool pre-service teachers about the concept of creativity in the relevant literature. One of these studies determined that pre-service teachers mostly associate creativity with nature (Pekdoğan & Kanak, 2015). In another study, students described the concept of creativity as producing unique and original products (Tok, 2015). In another study, in which the metaphors produced by the pre-service teachers studying in the classroom teaching program for the concept of creativity were examined, it was seen that the they associated the concept of creativity with being different (Çağlıyan, 2020). Based on these, it can be said that the findings of the literature on the versatility of the creative learning environment, in the opinion of pre-service teachers, are similar to the findings of this study.

When the categories developed by grouping the metaphors produced by the students were examined, it was determined that the students in the third and fourth grades emphasized the limitless aspects of creativity more frequently than those in the first and second grades. As Boden (2001) stressed understanding the subject matter of science is necessary for thinking creatively. So, this data can be interpreted as upper classes being aware of the importance of subject knowledge in the creative process. Creative learning environments should have features that focus on students' skills and interests (Fleith, 2000). Third graders stressed the entertaining side of creativity more often than students in other class levels. At the same time, students in the first and second grades conceptualize creativity as the ability to produce a unique product. However, as grade levels progressed, it was seen that circumstances conducive to developing creative thinking were stressed more through the use of metaphors. Different point of views can be argued that the perspectives of students towards creativity may have been shaped by the knowledge and experiences they gained in upper grades, such as "science teaching laboratory practices, teaching practicum and out-of-school learning environments in science teaching". So, upper classes are more aware of the aspects of creative science classrooms.

When the drawings made by the students for the creative science learning environment were examined, it was seen that they mostly included laboratory materials in their drawings. This may be due to the fact that the metaphors they developed for creative learning environments are also associated with the laboratory. Thus, pre-service instructors frequently stressed the exploratory nature of the creative learning environment. The laboratory for science lessons is effective in the development of creativity. Studies have shown that creative thinking skills develop when students have access to the laboratory at any time and can conduct various experiments (Hofstein, Shore & Kipnis, 2004). Moreover, activities carried out in nature contribute to individuals' creative thinking. To behave as scientists, individuals must comprehend nature and natural events (Gürbey, Mertoğlu, Sayan & Macaroğlu Akgül, 2022). Therefore, laboratories are essential for promoting positive attitudes toward science education, and they must be adequately equipped for efficient use (Bağ & Küçük, 2017; Çepni & Ayvacı, 2011; Ural & Başaran Uğur, 2018). When the students' drawings were examined, it was observed that they depicted laboratory materials not only in a laboratory setting but also in a classroom or nature. In this regard, it can be said that students do not limit the creative science learning environment to the laboratory; instead, they characterize any space with sufficient infrastructure as a creative science learning environment. Teachers will cultivate their students' creativity when they allow them to propose unique ideas and create flexible learning environments that enable them to find alternative solutions to problems. (Yenilmez &Yolcu, 2007).

To sum up, according to the metaphors and drawings, it can be said that students emphasized the exploratory, versatile, observable, entertaining and limitless aspects of creative science classrooms. Although all these fit with the literature, creative science classrooms are more than "laboratories" and "nature" for observation and exploration. None of the students stressed the importance of scientific inquiry in creative learning environments. The metaphors and drawings were not including the dimensions of scientific inquiry as asking questions, problem solving, designing and conducting investigations, forming hypothesis formation and formulating explanations and reflecting upon explanations and findings (Barrow, 2010).

When the metaphors created by the students for the creative science teacher were examined, it was seen that most of the metaphors were gathered under the "guide" category. Students in the first and second grades generally perceive the creative science teacher as guiding and directing. This finding is similar to the results obtained from previous studies. In the study of Zengin (2018), in which he examined the metaphorical perceptions of school principals towards the concept of a creative teacher, it was found that school principals generally described creative teachers as wise teachers who guide students and apply innovative education models to enrich their learning. Although this category is frequently emphasized by students in the first and second

grades, it has been noticed that metaphors for this category are developed at all grade levels. The teachers' ability to serve as role models and mentors is important for developing their students' creativity (Liuffin, 2014). Therefore, students may have described the creative teacher in this way. Likewise, Aljughaiman and Maurer-Reynalds (2005) underlined that teachers should emphasize the importance of creativity to develop their students' creativity skills, raise their awareness and encourage them to develop their creativity. The points considered important in teacher education were expressed by UNESCO (2002) as having the necessary equipment to develop creativity in students, being a role model, and encouraging creativity. According to the constructivist approach, students must understand what they have learned. For this reason, it was emphasized that the teacher should adopt supportive and facilitating roles (Tezci, Dilekli, Yıldırım, Kervan & Memeti, 2017). It can be said that metaphors such as light, compass, and guide produced by students coincide with the characteristics of creative teachers in the literature (Koç, 2014; Oxford et al., 1998). Students studying in the third grade mostly described the creative science teacher as being versatile. The reason for this can be explained by the fact that the creative teacher has many different characteristics. In the study conducted by Schreglmann and Kazancı (2016), it was discovered that students characterized the creative teacher as one who is continually evolving. In addition, Zengin (2019) examined the metaphorical perceptions of school principals toward the concept of a creative teacher. The study results show that shaping is an important and vital quality for creative teachers.

Another remarkable point is that students describe creative science teachers as having limitless knowledge. It was observed that students in the first and second grades generated more metaphors for this category than those in the third and fourth grades. According to students, a teacher must have limitless knowledge to be creative. For an individual to progress and be creative, he or she must have knowledge of his or her subject; yet, creative individuals think in several dimensions and can view circumstances from different angles (Çağlıyan, 2020).

When the students' metaphors for the creative science teacher were collected, they were categorized as extraordinary, individual differences, innovative, elaborative, process management, curious, and exploratory. San (2008) describes the creative teacher as someone who can invent, experiment, and conduct research. According to Fisher (2004), a creative teacher not only conducts the lesson in light of his knowledge but can also add and diversify different activities to the lesson. Jeffrey and Craft (2006) explain that creative teachers add new dimensions to traditional classrooms and make students more innovative by considering the needs of students and shaping education accordingly. In addition, elaboration is another category in which students' metaphors for the creative science teacher are gathered. Therefore, one of the dimensions of creative thinking is elaboration. Elaboration is defined as the process of enhancing by detailing particular events or concepts in greater depth (Edwards, 2014). Thus, students emphasized creativity's vital elements in creative processes. As mentioned in the relevant literature, it has been seen that there are many classifications for the characteristics of the creative teacher. Therefore, the students' perceptions of the creative science teacher coincide with the creative teacher characteristics in the literature.

CONCLUSION AND RECOMMENDATIONS

The study's findings concluded that most students described the creative science learning environment as a place conducive to discovery, such as the laboratory or nature. In addition, it has been established that there are grade-specific variances in the opinions of students about the creative learning environment. As the grade level progressed, students described environments that encourage creativity as limitless and entertaining, as well as versatile and conducive to discovery. On this basis, the pre-service teacher education effectively provides students with a broader and more diverse perspective on environments that foster creative thinking and creativity.

It was seen that the metaphors developed by the students for the creative teacher were gathered in the "guide" category. Although the number of metaphors produced by the first and second-grade students for this category is higher, it has been concluded that metaphors are produced for this category at all grade levels.

In line with this result obtained from the study, it can be suggested to investigate the factors that cause the change and development in the students' perspectives on creativity according to the grade level.

Ethics Committee Approval Information

Ethical approval was acquired from Trabzon University Ethics Committee with decision numbered E-81614018-000-2200018897 and dated 13.05.2022.

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APPENDICES

Creative Learning Environment: Metaphors

Versatile

Metaphors developed for the versatile category are listed in the table below.

Table 1. Metaphors of the Versatile Category

Category	Class	Metaphors	f	%
Versatile	1	Puzzle (4), lyrics (1), book pages (1), chain (1), factory (1), tumbler (1), ecosystem (1), tv series (1)	11	6,01
	2	Missing mascara in incomplete eye make-up (1), Canva (1), sky (1), nature (1), universe (1), multi program machine (1), library (1)	7	3,8
	3	Amusement park (2), sun (1), factory (1), laboratory (1), out of school learning (1), room full of stuff (1), puzzle (1), automobile (1), science fair (1), table (1)	11	6,01
	4	Nature (2), amusement park (1), universe (1), car engine (1), festival (1), scene (1)	7	3,8

Limitless

Metaphors developed for the limitless category are listed in the table below.

Table 2. Metaphors of the Limitless Category

Category	Class	Metaphors	f	%
Limitless	1	Universe (2), sun (1), space (1)	4	2,18
	2	Universe (1), laboratory (1), nature (1), space (1), sky (1)	5	2,73
	3	Pencil case (1), space (1), blank (1), Google (1)	4	2,18
	4	Sky (2), world (1), skyline (1), Miky Way galaxy (1), ocean (1)	6	3,27

Observable

Metaphors developed for the observable category are listed in the table below.

Table 3. Metaphors of the Observable Category

Category	Class	Metaphors	f	%
Observable	1	Laboratory (5), theater (1), abstract object (1), real life (1), scales (1), factory (1), science center (1), light (1), zoo (1)	13	7,10
	2	Nature (5), laboratory (2), world (1), life (1), theater (1), science center (1), sky (1), science-related goods (1)	13	7,10
	3	Movie theates (1), real life (1)	2	1,09
	4	Stage (2)	2	1,09

Exploratory

Metaphors developed for the exploratory category are listed in the table below.

Table 4. Metaphors of the Exploratory Category

Category	Class	Metaphors	f	%
	1	Laboratory (8), experimental setting (1), fair (1), campground (1), playground (1), world (1), the place where we can feel great emotions from small things (1), school (1), the room where secret potions are made (1)	16	8,74

Category	Class	Metaphors	f	%
Explorat ory	2	Laboratory (5), space (4), puzzle (1), campground (1), museum (1), science center (1), experimental table (1), inventing (1), factory (1), place of scientific research (1), shooting star from the sky (1), an island full of impossibilities (1), garden (1)	20	10,92
	3	Laboratory (1), planet (1), forest (1)	3	1,63
	4	All environments (1), laboratory (1), factory (1), play dough (1), nature (1)	5	2,73

Nature

Metaphors developed for the nature category are listed in the table below.

Table 5. Metaphors of the Nature Category

Category	Class	Metaphors	f	%
Nature	1	Nature (7), garden of the house (1), forest (1), world (1), laboratory (1)	11	6,01
	2	Forest (3), nature (2), events in nature (1)	6	3,27
	3	-	-	-
	4	Nature (2)	2	1,09

Needs-based

Metaphors developed for the needs-based category are listed in the table below.

Table 6. Metaphors of the Needs-Based Category

Category	Class	Metaphors	f	%
Needs-based	1	Library (1), technology (1), nature (1), building's foundation (1), the environment with science-related goods (1)	5	2,73
	2	Cloud (1)	1	0,54
	3	-	-	-
	4	Computer (1), stationery environment (1)	2	1,09

Creative Teacher: Metaphors

Versatile

Metaphors developed for the versatile category are listed in the table below.

Table 7. Metaphors of the Versatile Category

Category	Class	Metaphors	f	%
Versatile	1	Brain (2), wrench (1), tree branches (1), captain (1), solar system (1), rainbow (1), 0xygen (1), puzzle (1), matryoshka (1), tree (1), scientist (1), pencil (1), space (1)	14	7,65
	2	Ocean (2), colored beads (1), colors (1), factory (1), space (1), sun (1), scientist (1), computer (1)	9	4,91
	3	Forest (2), surprise box (1), world (1), stream (1), rainbow (1), painter (1), telephone (1), pomegranate (1), puzzle (1)	10	5,46
	4	Nature (1), rainbow (1), chameleon (1), lock box (1), actor (1)	5	2,73

Remarkable

Metaphors developed for the remarkable category are listed in the table below.

Table 8. Metaphors of the Remarkable Category

Category	Class	Metaphors	f	%
Remarkable	1	Clown (2), buffoon (1), scientist (1), physics teacher (1), intelligence cube (1), painter (1), cartoon (1), magic (1)	9	4,91
	2	Painter (1), surprise box (1), magician (1), scientist (1), theater artist (1)	5	2,73
	3	Magic box (1), star (1), fun day (1), Disney character (1), entertainer (1)	5	2,73
	4	Rainbow (2), mermaid (1), universe (1), nature (1), lock box (1), magician (1), treasure box (1), clown (1), theater artist (1)	10	5,46

Limitless knowledge

Metaphors developed for the limitless knowledge category are listed in the table below.

Table 9. Metaphors of the Limitless Knowledge Category

Category	Class	Metaphors	f	%
Limitless Knowledge	1	Book (2), pen (2), light (1), intellectual (1), philosopher (1), software developer (1), treasure (1), scientist (1), space (1), sun (1), Rick (1), the lead role in the series (1)	14	7,65
	2	Scientist (4), internet (1), naturalist (1), astronaut (1), forest protector (1), library (1), inventor (1), teacher (1)	11	6,01
	3	Library (2), computer (2), universe (1), science literate (1), space (1)	7	3,82
	4	Sky (1)	1	0,54

Individual Differences

Metaphors developed for the individual differences category are listed in the table below.

Table 10. Metaphors of the Individual Differences Category

Category	Class	Metaphors	f	%
Individual Differences	1	Knowledge (1), rainbow (1)	2	1,09
	2	Soil (1)	1	0,54
	3	Clown (1), tree (1)	2	1,09
	4	Rainbow (4), tree (1), scientist (1)	6	3,27

Innovator

Metaphors developed for the innovator category are listed in the table below.

Table 11. Metaphors of the Innovator Category

Category	Class	Metaphors	f	%
Innovator	1	Magician (2), researcher (1), original individual (1), magician (1), idol (1), dreamer (1), scientist (1), space (1), book (1), pencil (1)	11	6,01
	2	Scientist (3), comedian (1), cube (1), miracle (1), tree (1), engineer (1), imagination (1), computer (1), scholar (1)	11	6,01
	3	Matryoshka (1), pencil (1)	2	1,09
	4	Scientist (2), factory (1), speed of light (1), nature (1), painter (1), newsletter (1), ant (1), seed (1), theater actor (1)	10	5,46

Elaborative

Metaphors developed for the elaborative category are listed in the table below.

Table 12. Metaphors of the Elaborative Category

Category	Class	Metaphors	f	%
Elaborative	1	The one who prepares an experimental environment for the students with the materials they have in every condition (1)	1	0,54
	2	Filter (1), scientist (1), microphone (1), photographer (1)	4	2,18
	3	-	-	-
	4	Painter (1)	1	0,54

Process management

Metaphors developed for the process management category are listed in the table below.

Table 13. Metaphors of the Process Management Category

Category	Class	Metaphors	f	%
Process Management	1	Heart (1), time (1)	2	1,09
	2	-	-	-
	3	Ocean (1)	1	0,54
	4	World (1), comedian (1), scientist (1), superhero (1), freedom (1)	5	2,73

Curious

Metaphors developed for the curious category are listed in the table below.

Table 14. Metaphors of the Curious Category

Category	Class	Metaphors	f	%
Curious	1	Scientist (1), hero (1)	2	1,09
	2	Scientist (1), clown (1)	2	1,09
	3	Suprise gift (1)	1	0,54
	4	Scientist (1)	1	0,54

Explorer

Metaphors developed for the explorer category are listed in the table below.

Table 15. Metaphors of the Explorer Category

Category	Class	Metaphors	f	%
Explorer	1	Scientist (3), young child (1), researcher (1), inventor (1)	6	3,27
	2	Scientist (2), computer (1), magician (1), ant (1), worker bee (1)	6	3,27
	3	Wanderer (1), scientist (1), laboratory (1)	3	1,09
	4	Scientist (1), worker bee (1)	2	1,63

A Study on the Relationship Between School Principles' Technology Leadership and Life-long Learning Competencies

Okul Müdürlerinin Teknoloji Liderliği Yeterlikleri ile Yaşam Boyu Öğrenme Yeterlikleri Arasindaki İlişkinin İncelenmesi[1]

Hilal Gürkan[2]**, Yusuf Alpaydın**[3]**, Taner Tanoba**[4]

Abstract

Purpose: The aim of this study is to examine the relationships between technology leadership competencies and lifelong learning competencies of school principals and to reveal whether technology leadership and life-long learning competencies predict each other.

Design/Methodology/Approach: The research was designed according to the correlational survey method, as one of the quantitative research methods. The sample of the study is from 150 school principals of primary, middle, and high schools, that are public and private schools affiliated to Beykoz, Kadıköy, Üsküdar District Directorate of National Education in the 2017-2018 academic year. The data of the research were collected with the Technology Leadership Competence Scale, the Life-long Learning Competence Scale and the Personal Information Form. The data were analyzed by correlation and regression analyses.

Findings: As a result of the research; we found that technology leadership and life-long learning competency levels affect each other. Among the sub-dimensions of technology leadership, we found that only the dimension of excellence in professional development significantly predicted life-long learning competence. It is seen that life-long learning competence affects the level of technology leadership. However, it was found that none of the life-long learning competency dimensions significantly predicted technology leadership competency.

Highlights: In today's rapidly changing conditions, technology leadership is considered to be important. In this respect, the fact that life-long learning competence and technology leadership competence predict each other leads to the conclusion that steps should be taken to increase the competencies of administrators in this field in order to integrate the rapid changes brought by the digital age into education and training.

Öz

Çalışmanın amacı: Bu araştırmanın amacı okul müdürlerinin teknoloji liderliği yeterlikleri ile yaşam boyu öğrenme yeterlikleri arasındaki ilişkilerin incelenerek teknoloji liderliği ve yaşam boyu öğrenme yeterlikleri düzeylerinin birbirini yordayıp yordamadığını ortaya koymaktır.

Materyal ve Yöntem: Araştırma nicel araştırma yöntemlerinden ilişkisel tarama yöntemine göre desenlenmiştir. Çalışmanın örneklemini 2017-2018 eğitim-öğretim yılında Beykoz, Kadıköy, Üsküdar İlçe Milli Eğitim Müdürlüğüne bağlı resmi ve özel; ilkokul, ortaokul ve lise 150 okul müdürü oluşturmaktadır. Araştırmanın verileri Teknoloji Liderliği Yeterliği Ölçeği, Yaşam Boyu Öğrenme Yeterliği Ölçeği ve Kişisel Bilgi Formu ile toplanmıştır. Veriler korelâsyon ve regresyon analizleri ile çözümlenmiştir.

Bulgular: Araştırma sonucunda; teknoloji liderliği ve yaşam boyu öğrenme yeterliği düzeylerinin birbirini etkilediği belirlenmiştir. Teknoloji liderliği alt boyutlarından sadece mesleki gelişimde mükemmellik boyutunun yaşam boyu öğrenme yeterliğini anlamlı şekilde yordadığı belirlenmiştir. Yaşam boyu öğrenme yeterliğinin teknoloji liderliği düzeyini etkilediği görülmektedir. Ancak yaşam boyu öğrenme yeterliği boyutlarından hiçbirinin teknoloji liderliği yeterliğini anlamlı şekilde yordamadığı tespit edilmiştir.

Önemli Vurgular: Günümüzün hızla değişen koşullarında teknoloji liderliğinin önemli olduğu düşünülmektedir. Bu açıdan yaşam boyu öğrenme yeterliği ile teknoloji liderliği yeterliğinin birbirini yorduyor olması dijital çağın getirdiği hızlı değişimlerin eğitim ve öğretime entegrasyonu için yöneticilerin bu alandaki yeterliliklerini artırmaya yönelik adımların atılması gerektiği sonucuna ulaştırmaktadır.

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[1] This study was produced from the master's thesis titled "Examination of the Relationship Between Technology Leadership Competencies of School Principals and Life-Long Learning Competencies" completed in 2017 under the supervision of Assoc. Prof. Yusuf Alpaydın, within the scope of Istanbul Sabahattin Zaim University and Marmara University Joint Education Management Master's Program.

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INTRODUCTION

Today, the rapid development of science and technology forces educational institutions to change and develop. This situation has made it compulsory for education administrators to carry out change and innovation studies at school (Ağaoğlu, Altınkurt, Yılmaz, & Karaköse, 2012). The rapid development of technology has forced the school administrators to have some qualifications and equipment in all areas of education, with the influence of the learning culture that encourages the skills that require innovation, creativity, and innovation collaborations brought by the digital age. This has led to an increase in the effects on education and expectations from the school. As an effective teaching leader with a vision, school administrators take an active role in all processes related to education and training, act as a role model to teachers, students and employees in their institutions, and ensure the integration of technology into education in order to achieve academic and administrative goals. It is necessary to create technology-equipped learning centers and to use technology adequately and creatively (Sincar & Aslan, 2011, p.574).

While the importance of technology use in education increases with the schooling of the Z generation (Cilliers, 2017; Somyürek, 2014), it is seen that teachers and school principals have difficulties in using technology in schools (Çalık, Çoban, & Özdemir, 2019; Hero, 2020). With the pandemic conditions, education in schools has continued as online learning, blended learning or distance learning, resulting in the globalization of education (Harris, 2020). In this sense, it can be said that the use of technology has become even more important in schools. Especially in the period when face-to-face education was suspended due to the COVID-19 global epidemic, it is a question mark what kind of leadership school principals exhibit (Harris, 2020). In this period, when school administrators manage their schools through computers, it is important to clarify what behaviors the school principal should exhibit at the point of eliminating the difficulties.

Within the scope of the programs prepared by the schools during the pandemic period, the teachers also continued their lessons live through distance education through EBA. This situation has revealed how important the competence of teachers and school principals in the use of technology is in the 21st century, which is characterized as the age of information and technology. The preparation of the curriculum for the distance education process, the inclusion of teachers and students in the process, and the coordination of teaching were carried out under the leadership of school principals (Turan, 2020).

Technology leadership arising from the effective use of technology in rapidly developing technology and educational organizations is getting more important day by day (Yahşi, 2020). Technology leadership is a critical element of today's educational leadership, which is one of the most important factors for the successful integration of technology into the education system (Grey-Bowen, 2010). Banoğlu (2011) emphasizes that technology leadership is one of the basic leadership characteristics that education administrators should have in the 21st century. The technology leader is the person who carries out all the managerial activities necessary for the efficient use of technology (Tanzer, 2004). Technology leadership is the relationship between leadership and technology, where managers play a more active role in applying technology and try to bring people and information technology components together (Hamzah, Nordin, Jusoff, Karim, & Yusof, 2010).

Today's understanding of education requires school principals to train themselves not only as educational leaders, but also as technology leaders who use new information technologies and applications (Beytekin, 2014). School principals have one of the biggest responsibilities in the integration of technological developments into learning environments (Çalık et al., 2019). Considering how complex schools are as learning organizations, school administrators should have the necessary technological knowledge and lead the efficient and effective use of technology in educational institutions (Afshari et al., 2009).

The school principal should be technologically literate about information technologies, so that school personnel can also make good use of technology in education, create a teaching environment that facilitates students' motivation to learn, and achieve the goal of an effective school (Yahşi, 2020). Managers have the chance to provide better management while improving their institutions by making use of information and communication technology resources (ISTE, 2009). Effective use of technology in schools can provide support for the creation of a common vision and effective school goals (Edgerson & Kritsonis, 2006). Principals can play a key role in integrating teacher skills and existing technology, as the school administrator's technology leadership influences teachers' technological skills and their integration into the curriculum (Chang, 2012). Information technologies provides opportunities for effective and efficient decision-making in planning, budgeting and determining the development of the school to administrators (MEB, 2007).

The standards that school administrators at all levels should have regarding technology leadership are known as NETS-A (National Educational Technology Standards for Administrators) developed by ISTE (International Society for Technology in Education). These standards, which were first determined in 2002 and then republished in 2009, examine the technology leadership characteristics of school administrators and are grouped under 5 headings: 1. Visionary Leadership 2. Digital-Age Learning Culture, 3. Excellence in Professional Development 4. Systemic Improvement 5. Digital Citizenship.

Visionary leadership inspires and leads education administrators to develop and implement a common vision that supports excellence and transformation to enable technology integration into the teaching environment. Digital age learning culture enables education administrators to create and maintain a dynamic learning culture that delivers in-depth and engaging education for all students in the digital age. Excellence in professional development allows education managers support a professional learning and innovation-driven environment that empowers educators to improve student learning by integrating modern technology and digital resources. Systemic improvement refers to the fact that educational leaders are responsible for the efficient use of information and technology resources. It provides leadership and management in the digital age for the continuity of the

organization's development. Digital Citizenship is an understanding of the social, ethical, legal issues and responsibilities that foster a digital culture (Guven, 2015).

In the literature, many studies have been conducted on school administrators' technology leadership (Can, 2003; Bostancı, 2010; Hacıfazlıoğlu, Karadeniz, & Dalgıç, 2010; Küçükali & Ada, 2014; Irmak, 2015; Cantürk & Aksu, 2017), and technology leadership competence (Anderson & Dexter, 2005; Ergişi, 2005; Yu and Durrington, 2006; Banoğlu, 2011; Bülbül and Çuhadar, 2012; Can, 2003, 2008; Eren-Şişman, 2010; Sezer, 2011).

Developments in information and communication technologies, which rapidly change the way of living, learning and working, also cause changes in lifestyles and make it necessary to constantly acquire new knowledge and skills. However, the unique conditions of the information age necessitate the training of individuals who can think critically and have the ability to develop different approaches to problem-solving. This situation highlights the need for a life-long education. (Dağ, 2016). In today's information society, an educated person is defined as an individual who can follow the developments and changes related to himself and apply them to life, question, be open to development, and actively use information and communication technologies (MEB, 2009). In this context, development and adaptation to change are not only possible with the information learned in schools at all educational levels, and the individual needs to constantly renew and develop himself. In this context, one of the most important issues in the world and in Turkey in recent years is life-long learning. Continuous developments in the technological field significantly affect the up-to-dateness of our information. New knowledge and practices are rapidly replacing existing knowledge and practices. The way to keep up with change is through life-long learning.

The concept of life-long learning emerged in order to keep up with the rapidly developing and changing social and cultural life in line with the needs of the age, and has become an important indicator in terms of education level and employment conditions in developed and developing countries (HBÖSB, 2014-2018, p. 9) With an individual, societal, social and economic approach, life-long learning can be defined as all kinds of learning activities that individuals participate throughout their lives in order to improve his/her knowledge, skills, interests and competences (MEB, 2009).

With the widespread use of technological tools, it can be said that the use of all these technological tools has an encouraging role in life-long learning of people (Şentürk et al., 2011, p.66). Adaptation to technological development and change requires continuity in terms of society. It can be recommended that people attend in-service training, courses and seminars when necessary for ensuring continuity and individual development (HBÖSB, 2014-2018, p. 14).

The use of information technologies has become widespread in all education levels, especially with the pandemic process. Especially in adult education, these technologies provide opportunities such as expanding access opportunities, improving interaction, increasing the quality of learning, encouraging the use of learning opportunities, diversifying opportunities to acquire new knowledge and skills, and offering equal opportunities.

It is important to be aware of the opportunities and challenges created by digital technologies in order for each individual to benefit from information technologies in the information society and, this increases the importance of the concept of lifelong learning (Yildiz Durak & Tekin, 2020). In addition, considering the new approaches and methods applied in learning-teaching environments due to the technological developments in the 21st century, it can be said that teachers need to constantly improve their technology literacy skills and therefore they should have life-long learning (LLL) skills (Selvi, 2011).

Hylén (2015) stated that there are basically three reasons for the increasing use of information technologies in the context of lifelong learning. The first reason is that information technology has the capacity to improve learning. The second reason is that information technologies have the potential to expand access to learning opportunities. The last reason is that when using information technologies in the context of lifelong learning, these technologies also provide an opportunity for individuals to acquire digital skills that are necessary and very important for living and working in today's society (Gökkaya, 2014).

Gümüş (2016), on the other hand, emphasized the role of digital technologies in life-long learning in terms of open and distance learning, eliminating the difficulties and limited opportunities in reaching formal education for adults, flexible structure (in terms of time and space), and new career opportunities and diversity.

With change today, the best way to fulfill the inevitable obligations of being an information society is to increase life-long learning and technology leadership competencies. In particular, that our school administrators maintain lifelong learning as the educational dynamics of societies, have the equipment and technology competencies required by the age, and channel the education personnel in the light of these developments, reveals the importance of life-long learning in terms of providing the necessary revision in the society. In this respect, the research is considered important as it includes technology leadership in terms of preparing educational environments for educational leaders and involving education stakeholders in this process, and lifelong learning, which envisages the renewal of information in a dynamic process.

In this respect, it is thought that school principals' lifelong learning competencies are related to technology leadership competencies and may be predictors of each other at a significant level. In the literature review on technology leadership and life-long learning, it was found that there are studies in which different variables are examined. However, no study was found in which school principals were examined together with technology leadership and life-long learning. Therefore, we aim to reveal whether technology leadership explains the dimensions of life-long learning, and to contribute to the literature with original results.

The purpose of this research is to explain whether the technology leadership and life-long learning competencies of school

principals are significant predictors of each other. For this purpose, answers to the following sub-problems will be sought:

    1. Is there a significant relationship between the technology leadership competencies of school principals and their life-long learning competencies?

    2. Is technology leadership competence of school principals a significant predictor of lifelong learning competencies?

    3. Is school principals' life-long learning competence a significant predictor of technology leadership competencies?

METHOD/MATERIALS

The Model of The Study

The purpose of this study is to examine the level of the relationship between school principals' technology leadership competencies and lifelong learning competencies. Relational survey model was used in the research and relational survey models are research models in which two or more than two variables change together and/or the degree of change is tried to be determined (Karasar, 2016). Relational survey model is used in determining the relationships between variables, in studies that try to determine the extent of these relationships and in cases where it is not clear which variable affects which variable (Büyüköztürk et.al., 2013; Karakaya, 2012). In this study, the relationships between school principals' technology leadership competencies and lifelong learning competencies were examined. Relational studies are also designed to obtain data on the cause and effect of the relationship between two or more variables (Büyüköztürk et.al., 2013). In this context, in this study, it was tried to reveal the cause-and-effect relationship between the technology leadership competencies and lifelong learning competencies of the school principals participating in the research. In this study, relational survey model was used and the independent variables of the research were determined as technology leadership and the dependent variable of the research was determined as lifelong learning competencies.

The Universe and The Sample

The universe of the research consists of 390 school principals in public and private primary, secondary and high school institutions affiliated to Beykoz, Kadıköy and Üsküdar District Directorates of National Education. The sample of the study was determined by non-probability convenience sampling method. Convenience sampling, which is one of the non-probability sample types, is also known as the appropriate sample and is based on the principle of collecting data from the easiest and most accessible participants until the required size sample is reached (Gürbüz & Şahin, 2017). The sample number for the population was found to be 121 at the 90% confidence level with the sample calculation formula used for quantitative variable studies. The sample size used in the study adequately represents the population at the 90% confidence level. Considering the size of the determined districts and the difficulties of resources and time for reaching 390 school principals, a sample size of 150 was reached in this study.

Of the school principals constituting the sample, 100 (66.7%) were male, 50 (33.3%) were female; 112 (74.7%) of them have undergraduate education, 38 (21.3%) of them have postgraduate education. 33 (22%) of the school principals participating in the research are in the age range of 25-34 years, 69 of them (46%) 35-44 years, and 48 of them are (32%) 45 and over. Of the school principals included in the study, 32 (21.3%) had 1-10 years, 85 (56.7%) 11-20 years, 33 (22%) had 21 or more years of professional seniority. In terms of managerial experience, 40 (26.7%) of the participants had 1-2 years; 58 (38.7%) had 3-4 years; 52 of them (34.7%) had 5 years or more managerial experience. Of the school principals in the study, 56 (37.3%) work in primary school, 43 (28.7%) in secondary school, and 51 (34%) in high school. Of the teachers, 37 (24.7%) are classroom teachers, 56 (38.7%) are science and social teachers, 55 (36.7%) are teachers of other branches.

Data Collection Instruments

"Technology Leadership Competence Scale" and "Life-Long Learning Competence Scale" were applied in the 2017-2018 academic year after obtaining the necessary permission from the Istanbul Provincial Ministry of National Education and the developers of the scales for data collection. Research data were collected on a voluntary basis by going to schools within the framework of a predetermined program. Informed consent was obtained from the individuals before participating in the study. In addition, the confidentiality principle was taken into account during the data collection process and the participants were informed about this issue.

Analysis of the research results was carried out with the SPSS program. The assumption of normality in the study was determined by taking into account the skewness and kurtosis values. It is accepted that the normality assumption is valid in studies where skewness and kurtosis values are ±1.50 (Tabachnick & Fidel, 2013). While the skewness and kurtosis values of the technology leadership sub-dimensions were -.099 and -.222, the skewness and kurtosis values of the lifelong learning subdimensions were -.164 and -.209.

Correlation analysis was used to investigate the relationships between the variables, and simple and multiple regression analyses were used to determine the predictive level of the variables. Regression analysis is used to determine how the independent variables explain the dependent variables (Büyüköztürk, 2018). Before the data analysis, the data were examined for outliers to determine whether they were suitable for multiple linear regression analysis. Mahalanobis distance was calculated to determine the outlier values. Mahalanobis distance is used to determine how far a variable is from the mean and center of other variables. In this way, outlier values can be detected (Esen and Timor, 2019). In this framework, 8 data points, which were determined to be

extreme values in the study, were excluded from the data and the study was continued with the data obtained from 150 participants. In order to determine whether the multiple linear regression analysis has a multicollinearity issue, VIF and Tolerance values were examined. It was determined that there was no correlation value above .80, which can be defined as multicollinearity (Table 3), tolerance values were higher than .20, VIF values were less than 10 and, CI values were less than 30. The Durbin-Watson value was checked to examine the condition of the errors being independent. It was found that the value is between 1-3 (DW=1.78) and does not pose a problem. It was shown that the data obtained depending on the examinations were suitable for multiple linear regression analysis. The data obtained in the study were analyzed with the multiple linear regression analysis method. The significance level of .05 was used in the study (Akbulut, 2010; Büyüköztürk, 2011).

FINDINGS

In the findings part of the research; firstly, the arithmetic mean and standard deviation values of the research group's technology leadership and lifelong learning proficiency scores, then the simple correlation analysis coefficients for the variables, and finally the multiple linear regression analysis results for predicting each other of technology leadership and lifelong learning competencies are given.

The arithmetic mean and standard deviation values of the research group's technology leadership proficiency level scores are given in Table 1.

Table 1. The Arithmetic Mean and Standard Deviation Values of the Scores of School Principals from the Technology Leadership Competencies Scale and its Sub-Dimensions

Dimension	N	$\overline{X}$	Ss
Visionary leadership	150	3,93	8,527
Digital age learning culture	150	4,09	2,218
Excellence in professional development	150	4,02	5,401
Systemic improvement	150	3,85	2,396
Digital citizenship	150	4,09	4,731
Total Scale	150	3,99	21,018

The technology leadership proficiency average of the sample participating in the research was found as 3.99. While the dimension with the highest average among the dimensions of technology leadership was digital age learning culture and digital citizenship, it was seen that the dimension with the lowest average was the dimension of systemic improvement. The arithmetic mean and standard deviation values of the research group's life-long learning proficiency level scores are given in Table 2.

Table 2. The Arithmetic Mean and Standard Deviation Values of School Principals' Scores from the Life-Long Learning Competencies Scale and its Sub-Dimensions

Dimension	N	$\overline{X}$	Ss
Self-Management Competencies	150	4,12	7,755
Learning to Learn Competencies	150	4,10	7,237
Initiative and Entrepreneurship Competencies	150	4,16	5,779
Obtaining Information Competencies	150	4,32	3,926
Digital Competencies	150	4,30	4,263
Decision-Making Competencies	150	4,07	2,842

The average of life-long learning competencies of the participants participating in the research was found as 4.16. Among the life-long learning dimensions, the highest average was of information obtaining and digital competencies, while the lowest average dimension was seen to be the decision-making competence dimension.

Table 3. The Results of The Correlation Analysis Between Life-Long Learning and Technology Leadership Competencies of School Principals

		Technology Leadership Competence
	r	,539**
Life-Long Learning	p	,000
	n	150

**P<.01

As seen in Table 3, it was found that there is a significant positive relationship between life-long learning and technology leadership competence. Based on this finding, it can be said that as life-long learning competence increases, technology leadership

competence also increases. In addition, when Table 3 is examined, it can be defined as multicollinearity among the predictive variables. It was also observed that there was no correlation value above 80.

Table 4 presents the results of the simple regression analysis performed to understand whether the level of technology leadership competence has an effect on the general level of life-long learning competence.

Table 4. The Effect of Technology Leadership on Life-Long Learning Competencies

Variables	B	Std. Error	(β)	R^2	t	p
Constant	2,356	,236			9,986	,000*
Technology Leadership	,454	,058	,539	,290	7,784	,000*

When Table 4 is examined, it is seen that the level of technology leadership significantly predicts the level of life-long learning competence (p<.05). Technology leadership explains 29% of life-long learning proficiency level (R2= .290).

The results of the multiple regression analyses conducted to determine to what extent the sub-dimensions of the technology leadership scale predict lifelong learning are presented in Table 5.

Table 5. Results of Multiple Regression Analyses Between Life-Long Learning and Technology Leadership Competencies of School Principals

Variables	B	Std. Error	(β)	t	p
Constant	116,025	12,160		9,542	,000
Visionary Leadership	,169	,431	,051	,393	,695
Digital Age Learning Culture	1,457	1,552	,114	,939	,349
Excellence in Professional Development	1,575	,776	,301	2,028	,044*
Systemic Improvement,	-1,170	1,464	-,099	-,799	,426
Digital Citizenship	1,370	,760	,229	1,802	,074

*p<0,05

As seen in Table 5, when the results of the multiple regression analysis regarding the predictive value of visionary leadership, digital age learning culture, excellence in professional development, systemic improvement, and digital citizenship on of life-long learning in technology leadership is examined, it was concluded that only the excellence in professional development dimension had a significant effect on lifelong learning (p<.05).

The results of the simple regression analysis performed to understand whether the level of life-long learning competencies have an effect on the level of technology leadership are given in Table 6.

Table 6. The Effect of Lifelong Learning Competencies on Technology Leadership

Variables	B	Std. Error	(β)	R^2	t	p
Constant	1,323	,345			3,833	,000
Life-Long Learning	,639	,082	,539	,290	7,784	,000*

*p<0,05

When Table 6 is examined, it is seen that the level of life-long learning competence significantly predicts the level of technology leadership (p<.05). Life-long learning explains 29% of the technology leadership competence level (R2= .290).

The results of multiple regression analyze conducted to determine to what extent life-long learning sub-dimensions predict technology leadership are presented in Table 7.

Table 7. Results of The Multiple Regression Analyzes Between Life-Long Learning and Technology Leadership Competencies of School Principals

Variables	B	Std. Error	(β)	t	p
Constant	42,262	11,295		3,742	,000
Self-Management Competencies	-,202	,405	-,074	-,499	,619
Learning to Learn Competencies	,561	,453	,193	1,238	,218
Initiative and Entrenepreneurship Competencies	,682	,623	,187	1,095	,275
Obtaining Information Competencies	,298	,683	,056	,436	,664

Variables	B	Std. Error	(β)	t	p
Digital Competencies	,797	,538	,162	1,483	,140

When the results of the multiple regression analysis regarding the prediction of the dependent variable technology leadership by the independent variables life-long learning competencies and its sub-dimensions was examined, no significant effect was found in any sub-dimension.

DISCUSSION

In this study, it was revealed whether there is a relationship between technology leadership and life-long learning, and whether technology leadership and life-long learning levels predict each other significantly. The findings were discussed within the scope of the literature.

The average life-long learning competencies of the participants in the study were found to be 4.16 (strong). When this result is compared with the results in the literature, it is seen that there are similarities and differences. In the research carried out to determine the life-long learning tendencies of teachers within the scope of related studies (Özçiftçi, 2014; Kılıç & Ayvaz Tuncel, 2014; Ayra, 2015; Dündar, 2016), it was concluded that teachers' lifelong learning tendencies are high. Contrary to this study; Tunca, Şahin Alkın, and Aydın (2015) found the life-long learning levels of teacher candidates to be low.

The technology leadership proficiency average of the participants in the study was found as 3.99 (strong). When similar studies are examined in the literature, it is seen that there are studies supporting that school administrators' technology leadership self-efficacy is high (Doğan, 2018; Bülbül & Çuhadar, 2012; Banoğlu, 2011; Sincar & Aslan, 2011; Eren & Şişman, 2010, Ergişi, 2005). The study by Song, Liang, Liu, and Walss (2005) differs from the results of our research.

In the study, it was seen that the dimension with the lowest average among the dimensions of technology leadership competencies was the dimension of systematic development. Unlike the results of the research, in a metaphorical study on the technological leadership of school administrators (Hacıfazlıoğlu, Karadeniz, & Dalgıç, 2011), the metaphors produced by school administrators were divided into 5 conceptual categories, and systemic improvement took place in the 2nd category with the highest level. The trainings and studies that school administrators will participate in for systematic development are very important. School administrators can be a model for the use of technology in schools, and can encourage teachers to integrate technology into teaching and learning processes.

As a result of the research, it was found that there is a positive and significant relationship between technology leadership and life-long learning competencies. As life-long learning competence increases, technology leadership competence also increases. This finding is similar to the study conducted by Kabataş and Karaoğlan Yılmaz (2018). Kabataş and Karaoğlan Yılmaz (2018) found that there is a positive relationship between teachers' life-long learning and their self-efficacy towards educational technology standards. The fact that there is a positive relationship between life-long learning and technology leadership in the study suggests that technology leadership is necessary to keep up with the times in today's changing conditions. In this respect, it reveals the conclusion that steps should be taken to increase the technology competencies of managers. It is thought that technology leadership characteristics can be improved with in-service trainings to be given to school administrators. Şişman-Eren (2010) stated that technology leadership behaviors of principals differ with the training they receive. According to Yahşi (2020), as a result of examining the technology leadership self-efficacy of school principals according to the variable of receiving education in the field of IT, there is a significant difference in favor of managers who have received IT education in all of the total scores and sub-scores. This finding can be interpreted as IT in-service programs are effective in helping school administrators develop their technology leadership self-efficacy. In addition, it can be said that in-service training in the field of IT is beneficial in terms of using new programs and developing innovative approaches. School management also needs to improve themselves and they need to participate in in-service training activities together with other teachers.

CONCLUSION AND RECOMMENDATIONS

As a result of this study, it was seen that technology leadership and life-long learning variables were significant predictors of each other. While technology leadership explains 29% of life-long learning competence level, life-long learning explains 29% of technology leadership competence level.

There is a positive relationship between life-long learning and technology leadership. When the results of multiple regression analysis regarding whether the predictive variables of Visionary Leadership in Technology Leadership, Digital Age Learning Culture Excellence in Professional Development, Systemic Improvement, and Digital Citizenship predict lifelong learning, which is the dependent variable, it was concluded that there was a significant relationship (R= .569, R2= .324, p<.01). According to the standardized regression coefficient (β), the relative importance of the predictor variables on life-long learning is as the following: Excellence in professional development, Digital Age Learning Culture, Digital citizenship, Visionary Leadership, and Systemic Improvement. When the t-test results regarding the significance of the regression coefficients were examined, it was seen that the excellence in professional development sub-dimension was an important (significant) predictor, while the other sub-dimensions did not have a significant relationship. Unlike the results of the research, Görgülü and Küçükali (2018) determined that teachers have the lowest self-efficacy in professional development. It can be interpreted that the school principal explains the importance of lifelong learning by including technology trainings within the school for the integration of technology, which is one

of the elements of the excellence sub-dimension in professional development, with education and training, as well as in-service trainings that will enable teachers to learn by doing and experiencing for the necessary adaptation to the rapidly developing technology.

When the results of the multiple regression analysis regarding the prediction of technology leadership, which is the dependent variable, by the independent variables of "Self-Management Competencies, Learning to Learn Competencies, Initiative and Entrepreneurship Competencies, Information Obtaining Competencies, Digital Competencies and Decision Making Competencies", which are the subdimensions of life-long learning, it was concluded that there was a significant relationship (R= .554, R^2= .307, p<.01). According to the standardized regression coefficient (β), the relative importance of the predictor variables on lifelong learning is as the following: digital competencies, decision-making competencies, initiative and entrepreneurship, learning to learn competencies, self-management competencies, and knowledge management competencies. Similar to the results of the research, it is seen that digital competencies are at the forefront in studies on technology leadership of school administrators (Durnalı, 2019; Eren & Kurt ,2011; Hsiang & Tang, 2014). Related studies show that school administrators are conscious of the use of technology leadership strategies and that these administrators generally have a high level of effectiveness in school management. Similar to the results of the research, Gulpan and Baja (2020) found that school principals also benefit from technology in the decision-making and policy-making process in their study. Considering the fact that the entire communication network between national education and school is made through the internet and computer in school management, and also considering the distance education during the pandemic process, this explains the reason why digital competencies are at the forefront of life-long learning, .

The use of information technologies has become widespread in all education levels, especially with the pandemic process. School administrators should be able to monitor the rapid changes that occur in educational environments, adopt technology, and have the ability to manage the process, especially in the process of increasingly widespread distance education (Nworie, 2012). A good technology leader will make a big difference in integrating technology into schools, so school administrators, as technology leaders, should support technology integration in school management and its use in the classroom, and help staff acquire the necessary competencies.

In order for the necessary technological hardware and software for educational environments to be selected correctly, school administrators should determine the requirements and make vision analyses. It should consider the needs of the users, cooperate with the internal and external stakeholders of the school and involve them in the decision process.

School administrators should exhibit their leadership roles more in order to use technology more effectively in educational environments. School administrators should use more tools such as school website, e-mail, social media etc. for a more effective communication process independent of time and environment in the communication and cooperation process with teachers, students and parents.

The fact that there is a positive relationship between the technological leadership competencies of school principals and their lifelong learning, is considered important in terms of creating new horizons for schools and educators by increasing the technology leadership competencies of school leaders, in order not to fall behind the rapidly changing technological changes in the world.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

Author 1 developed the plan and theory of the research under the mentorship of author 2. Author 3 assisted with data collection and analysis. The author 2 made editing and correction studies at every stage of the research. Author 1 and author 3 jointly undertook the writing of the conclusion and discussion.

Researchers' contribution rate

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

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| Research Article / Araştırma Makalesi|

Cyber Psychology from Educational Administration Perspective: Teachers and School Administrators' Qualitative Insights

Eğitim Yönetimi Penceresinden Siber Psikoloji: Öğretmenlerin ve Okul Yöneticilerinin Nitel İçgörüleri[1]

Su ERTÜRK[2], **Gülnihal YILDIRIM**[3], **Temel ÇALIK**[4]

Abstract

Purpose: This study aims to cultivate awareness of the phenomena of bullying and security within the framework of cyber psychology. In line with this primary objective, the experiences and awareness levels of participating school administrators and teachers were examined.

Method: A descriptive phenomenological design, supported by a large sample, was employed to explore the semantic spectrum of cyber security and cyber bullying concepts. The study group consisted of 192 teachers and 64 school administrators, selected through purposeful sampling, specifically convenience sampling. A semi-structured online interview form served as the data collection tool. Content analysis was conducted with the goal of conceptualizing the data and identifying themes that describe the phenomenon. The findings are presented through descriptive narratives.

Findings: The findings reveal the significant emotional distress and security concerns negatively influenced by cyber psychology. Additionally, it has been found that cyberbullying and security issues lead to serious consequences for individuals, such as loss of self-confidence, social isolation, persistent anxiety, and long-term psychological trauma.The data reveal that females are the gender most frequently subjected to cyber bullying, with the most vulnerable age group being 14-18, followed by the 11-14 age range. The identified sub-themes of cyber bullying include fraud, hacking, violation of privacy, verbal abuse, blackmail, threatening and psychological violence.

Highlights: By examining the experiences of participants across a large sample, the study broadens the understanding of cyber bullying and security concepts. The detailed analysis of sub-themes provides both theoretical insights and practical recommendations for policymakers and practitioners. The study serves as an important reference to enhance awareness among teachers and school administrators who are the closest to children and youth in school and to develop measures that address the increasing challenges of internet use in education.

Öz

Amaç: Araştırmanın amacı siber psikoloji çerçevesinde zorbalık ve güvenlik olgularına yönelik farkındalık oluşturmaktır Bu temel amaç çerçevesinde, araştırmaya katılan okul yöneticileri ve öğretmenlerin deneyimleri ve farkındalık düzeyleri incelenmiştir.

Yöntem: Araştırmada siber güvenlik ve siber zorbalık kavramlarının anlam yelpazesini vurgulamak için büyük bir örneklemle desteklenen betimleyici fenomenolojik desen tercih edilmiştir. Çalışma grubu, amaçlı örnekleme yöntemlerinden uygun örnekleme ile seçilen 192 öğretmen ve 64 okul yöneticisinden oluşmaktadır. Veri toplama aracı olarak yarı yapılandırılmış çevrimiçi görüşme formu kullanılmıştır. Verilerin ayıklanması ve düzenlenmesinden sonra gerçekleştirilen içerik analizi, kavramsallaştırma ve olguyu tanımlayabilecek temaları ortaya çıkarmak amacıyla titizlikle betimsel anlatımlarla sunulmuştur.

Bulgular: Araştırma bulguları, katılımcıların deneyim ve gözlemlerine dayanarak, siber psikolojinin olumsuz etkilediği önemli duygusal stres ve güvenlik kaygılarını ortaya koymaktadır. Ayrıca, siber zorbalık ve güvenlik sorunlarının, bireylerde özgüven kaybı, sosyal izolasyon, sürekli kaygı ve uzun süreli psikolojik travma gibi ciddi sonuçlara yol açtığı bulunmuştur. Veriler, siber zorbalığa en sık maruz kalan grubun kadınlar olduğunu, en savunmasız yaş grubunun ise 14-18 yaş arası olduğunu, bunu 11-14 yaş grubunun takip ettiğini göstermektedir. Belirlenen siber zorbalık alt temaları ise dolandırıcılık, hesapların hacklenmesi, mahremiyet ihlali, sözlü taciz, şantaj, tehdit ve psikolojik şiddet olarak sıralanmıştır.

Önemli Vurgular: Araştırma, geniş bir katılımcı grubunun deneyimlerini inceleyerek siber zorbalık ve güvenlik kavramlarının anlaşılırlığını genişletmektedir. Dolandırıcılık, bilgisayar korsanlığı, mahremiyetin ihlali, şantaj, tehdit ve psikolojik şiddet gibi alt temaların detaylı analizi, hem teorik içgörüler hem de politika yapıcılar ve uygulayıcılar için pratik öneriler sunmaktadır. Bu kapsamda çocukların ve gençlerin okullarda en yakınındaki öğretmen ve okul yöneticisi kesiminin farkındalığını artırmak ve eğitimde internet kullanımının artan zorluklarına karşı önlemler geliştirmek için stratejik ve önemli bir referans niteliğindedir.

INTRODUCTION

Changing lifestyles and constant digital presence are affecting the minds of millions of young people as the average time spent on the internet is rapidly increasing. Young people spend a lot of time chatting online with their friends through social networks, playing online games with their peers, and shopping for products online (Ahuja & Alavi, 2017). In this respect, although digital technologies and the internet provide great convenience in our lives, they turn into a significant problem when used unconsciously. It is known that not having sufficient awareness and the use of technology and internet reaching the addiction level hinders the development of young generations in particular and leads to the development of individuals harmful to society (Akcan, Öztürk & Şarlak, 2020). In addition, activities related to daily life are carried out in the cyberspace, away from all physicality and boundaries, and have penetrated into each individual's home and even into their room. Individuals have to integrate their representations and identities in this cyberspace with their representations and identities in the real, actual space. It is stated that the failure to carry out this integration process in a functional manner most of the time causes grievances (Öztürk, Ateş & Erdoğan, 2020). On the other hand, processes related to the wrong and negative use of digital technologies, also called cyber bullying, which are also emphasized by the United States, European countries, China, Korea and Taiwan, attract attention (Baek & Bullock, 2013). In this regard, it can be said that one of the sources of these grievances is cyber bullying.

In the research conducted by Rigby (2003) on cyber bullying, it is stated that students who are victimized in this sense face many mental, physical and psychological problems such as 'low psychological well-being', 'poor social adaptation', 'psychological stress and anxiety', 'physical disorders'. Telephones, computers, etc., which are also used as a part of learning in the context of the digital and technological processes mentioned above. It is also stated that the use of internet along with technological devices will cause some difficulties for educators. In this context, the concept of cyber psychology, which is also discussed as internet psychology or web psychology (Ahuja & Alavi, 2017; Singh, 2019), focuses on the psychological aspects associated with the increasing presence and use of technology.

Cyber psychology refers to the study of mind and behavior in the context of interactions with technology. It also considers how people interact with each other in these environments and considers the impact of emerging trends such as technological convergence and the digital divide on individuals (Kirwan, 2010a). The importance of the field of cyber psychology in educational circles is increasing day by day, due to the prevalence of digital technologies in daily life and the inevitable use of them in educational processes. In this direction, undergraduate and graduate programs have begun to be opened in this field in Ireland, England and Russia (Voiskounsky, 2021). It can be said that academic research on the basis of cyber psychology and security has increased in recent years. In these studies, Extending the school grounds? Bullying experiences in cyberspace (Juvonen and Gross, 2008); the impact of parental online security practices, bonding, and online impulsiveness (Floros et al. 2013); student safety from cyberbullies, in chat rooms, and in instant messaging (Wolfsberg & Jeffrey, 2006); return of the hacker as hero: fictions and realities of teenage technological experts (Dudek and Johnson, 2011); effects of cyber bullying on students' academic, social and emotional states (Akbıyık & Kestel 2016), gratitude as a protective factor for cyberbullying victims: Conditional effects on school and life satisfaction (Oriol, Varela & Miranda, 2021); cyberbullying and victimization status of secondary school students: change in 10 years (Ayas & Horzum, 2023) as can be understood from the titles, there are studies covering student safety, the academic, psychological and emotional effects of cyberbullying, and the safety of those who are exposed to cyberbullying at school and their families.

Cyber Psychology

A new branch has emerged that focuses on the psychological aspects associated with the increasing presence and use of technology. This field, defined as cyberpsychology, refers to the examination of mind and behavior in the context of interactions with technology (Singh, 2019). Cyber psychology is an interdisciplinary field of study that focuses on psychological phenomena that occur as a result of human interaction with digital technology, especially the internet (Saltik, 2021). Cyber psychology emphasizes the study of people's interactions with the internet, mobile computing, cell phones, game consoles, virtual reality, artificial intelligence, and other technologies that have proven ability to change human behavior (Kirwan, 2010b). As developing digital technologies and internet use become a very important part of our daily lives, the study areas of cyber psychology have spread over a wide area. In this context, the aim of cyber psychology is to maintain and formalize a scientific understanding of the impact, dynamic processes and outcomes that digital technologies enable in individuals, groups and wider society (The British Psychological Society, 2019).

Cyber Bullying

Although technological developments make people's lives easier, they also bring negative effects on the lives of individuals or groups. Some digital platforms can serve as an environment where individuals engage in malicious behavior, including harassing others. In this regard, individuals may find themselves in the process of cyberbullying, which means the repeated and intentional use of various types of technology such as mobile phones, pagers, e-mail, instant messaging and Web sites by individuals or groups to harm others (Beran & Li, 2005). According to Ybarra and Mitchel (2004), one of the first researchers on cyber bullying, cyber bullying is a deliberate and open attack against another person online. Examples of this action include making rude or abusive comments towards someone, or deliberately shaming another user in retaliation for perceived wrongdoing. It is stated that clarifying the conceptual and operational definitions of cyberbullying can strengthen the ability of various stakeholders to identify,

prevent and respond to relevant activities (Patchin and Hinduja, 2015). In this context, the conceptual definition of cyberbullying; It can be defined as the conscious use of communication technologies by an individual or a group by sending or publishing offensive text, images, in order to intentionally and repeatedly harass or threaten another individual or group (Mason, 2008).

Cyber Security

Cyber security is defined by the International Telecommunication Union (ITU) as "guidelines, policies, tools, risk management approaches, practices, ensuring the integrity and usability of information and data in the cyber environment belonging to individuals, private and public institutions within the scope of confidentiality protocols, and the sustainability of infrastructures." It is expressed as the use of "technologies and trainings" (ITU, 2018). Within the framework of cyber security studies, the Cyber Security Board was established in Turkey. Through this board, the National Cyber Security Strategy and Action Plan 2013-2014 came into force in 2012. In addition, the target determined within the scope of the National Cyber Security Strategy and Action Plan 2020-2023 is expressed as reducing the effects of cyber threats, developing national capabilities, creating a safer national cyber environment and ensuring that our country ranks at the top at the international level in the field of cyber security (Transportation and Infrastructure Ministry, 2020).

This research aims to raise awareness about the psychological and physical effects of uncontrolled and uneducated digital use within the context of educational management and seeks to fill a significant gap in the field of cyber psychology. By examining the perspectives and experiences of school administrators and teachers, who are key figures in reaching children and young people, the study provides valuable data and strategic recommendations. The significance of this research lies in offering guidance and innovative insights by linking these issues to national and international educational strategies, thereby making a unique contribution to the academic literature. With the prediction that education administrators and teachers need more research and awareness about the problems encountered in the cyber world, this research aims to examine cyber psychology within the framework of educational management and raise awareness about cyber security. In this context, the lack of groundwork on cyber psychology will be addressed, and results and recommendations based on research findings will be presented to researchers. It is expected that this study will guide decision-makers at both national and international levels regarding the importance of cyber psychology and cyber threats.

Within the framework of the main purpose of the research, answers were sought for the following sub-objectives:

1. According to school administrators and teachers, what is their experience of being subjected to a cyber attack/bullying by themselves or a relative/ an acquaintance?

2. What are the effects of cyberbullying and cybersecurity problems on victims, according to school administrators and teachers?

3. How do school administrators and teachers interpret the age group and gender most exposed to cyberbullying?

4. What are the themes and subthemes that emerge according to the cyberbullying experiences of school administrators and teachers?

METHOD

Pattern of the Research

The research employed a phenomenological design, a qualitative research method that seeks to understand the essence of experiences related to a specific phenomenon. Phenomenology aims to answer the question, "What is truth?" by focusing on individual experiences and emphasizing description over generalization (Groenewald, 2004). In this research, the Descriptive Phenomenology approach was chosen to understand the effects of participants' experiences with cyberbullying, cyber psychology, and cybersecurity in an unbiased way and to reveal the essence of these experiences. Husserl (1931), the founder of Descriptive Phenomenology, emphasized understanding how a phenomenon is experienced by participants and identifying commonalities in these experiences. Husserl highlighted the importance of describing individuals' subjective experiences objectively, requiring researchers to set aside personal biases (*epoche*). Our study aims to detail the psychological and social impacts of cyberbullying as described by participants and to emphasize the significance of these experiences for societal awareness. This methodological framework enables a clear depiction of the phenomenon and faithfully reflects participants' experiences (Creswell, 2013; Husserl, 1931).

To ensure the validity of phenomenology, well-defined inclusion criteria were crucial. Participants were selected from Ankara's central districts, areas characterized by continuous migration and demographic shifts that influence social dynamics and increase the risk of bullying, including cyberbullying (Yıldırım & Şimşek, 2021; TÜİK, 2022). These economically developed districts provide significant access to digital technologies, facilitating both positive and negative online interactions, which is critical for understanding cyber phenomena (Livingstone & Smith, 2014; Tokunaga, 2010). According to data from the Household Information Technologies Usage Survey (2023) by the Turkish Statistical Institute (TÜİK), the rates of internet and computer access are high in these economically developed regions. Similarly, the Ministry of National Education's (MoNE) " Technology and Education from the Perspective of Teachers on the 100th Anniversary of the Republic: Regional Workshop Report" (2024) states that schools are

better equipped in terms of access to digital resources, which significantly influences the online experiences of students and teachers. This economic infrastructure is a critical factor in understanding cyber interactions within the context of the research.

Inclusion criteria ensured that participants, specifically school administrators and teachers, had direct and meaningful experiences with cyberbullying and cyber security. The pandemic's shift to remote education further emphasized the importance of digital literacy among students and educators in these areas. Additionally, migration to Ankara increased after the February 2023 earthquake, as the city is outside the disaster zone, adding to integration challenges that can lead to conflict and bullying (UNESCO, 2021; Yıldırım & Şimşek, 2021). Exclusion criteria were established to maintain the study's focus, excluding individuals not employed in formal elementary, middle, or high schools in Ankara's central districts during the 2022-2023 academic year. Other exclusions included staff from private institutions, preschool teachers, and those who did not fully respond to research questions or lacked relevant experiences. This structured approach ensured that the study captured a comprehensive range of perspectives related to cyber psychology, cyber security, and cyberbullying.

Study Group

In this study, a purposive sampling method, specifically convenience sampling, was employed to select participants with potentially rich and relevant information such as teachers and school administrators, who possess direct knowledge and experience of the phenomenon, allowing for an in-depth investigation of cyberbullying, an issue affecting educational environments (Yıldırım & Şimşek, 2021). This method not only facilitated the collection of rich and meaningful data from participants but also offered practical advantages in terms of time and resource constraints (Creswell & Poth, 2018). Additionally, such sampling methods are highly beneficial in exploratory research, where the goal is to gather in-depth insights from a specific group (Patton, 2002). Initially, the target sample size was set between 100-150 participants. However, as data emerged, it became clear that the contributions to the field were substantial, which encouraged us to expand the sample size. Literature on phenomenological research, including works by Polkinghorne (1989) and Smith and Shinebourne (2012), highlights the importance of larger samples for certain topics. Consequently, the sample size was increased as a result of the numerous interesting and in-depth responses, leading to the continuation of the data collection process. In phenomenological research, sample size can vary depending on the research objectives and subject matter. While Polkinghorne (1989) suggests up to 325 participants, Dukes (1984) recommends smaller groups of 3-10 individuals. However, in fields like education and healthcare, larger samples are often preferred to enhance data diversity and facilitate comprehensive analysis (Smith & Shinebourne, 2012; Finlay, 2014). Given the multifaceted nature of cyberbullying as a societal issue, a larger, more diverse sample allowed for a more thorough understanding of the phenomenon, with teachers and school administrators offering various perspectives that enriched the analysis.

Table 1. Demographic Properties of Participants

District	Duty		School Type			Age				Gender	
	Teacher	School Administrator	Primary	Secondary	High School	24-34	35-45	46-56	57&Upper	Female	Male
Altındağ	9	5	6	7	1	6	4	3	1	9	5
Çankaya	37	9	27	12	7	9	26	11	-	37	9
Etimesgut	12	7	7	7	5	6	11	1	1	17	2
Gölbaşi	10	6	6	4	6	1	7	7	1	10	6
Keçiören	24	9	9	7	17	7	17	8	1	20	13
Mamak	13	8	4	10	7	6	11	4	-	14	7
Pursaklar	48	10	11	24	23	15	28	13	2	38	20
Sincan	11	4	4	8	3	4	10	1	-	10	5
Yenimahalle	28	6	7	18	9	12	16	6	-	25	9
Total	192	64	81	97	78	66	130	54	6	180	76

Participants were reached through a structured online approach, where a semi-structured questionnaire was distributed to school administrators and teachers via district education directorates. Data collection was carried out with participants voluntarily completing the forms using their personal devices, ensuring ethical standards and privacy were upheld. According to Creswell (2013) and Bryman (2016), online data collection methods provide flexibility and anonymity, which can lead to more honest and reliable responses. Reips (2002) also emphasizes that the absence of physical and social pressure in online surveys enhances the

accuracy of responses. This method contributed to the reliability and validity of the data, particularly in the context of cyberbullying and online safety issues. After a month of data collection, we observed that new responses began to overlap with prior explanations, signaling data saturation. This indicated that no new significant insights were being gained from additional participants. As a result, we decided to close the survey and halt data collection. Ultimately, the final sample consisted of 192 teachers and 64 school administrators from formal primary, secondary, and high schools in central districts of Ankara, all affiliated with the Ministry of Education. The demographic data of the participants who filled out the data collection tool on a voluntary basis and whose data were evaluated are shown in Table 1. The large sample size proved beneficial in gaining a comprehensive understanding of the complex nature of cyberbullying and contributed valuable insights to the field. This research lays a solid foundation for future educational policies and interventions aimed at addressing cyberbullying (Creswell & Poth, 2018; Van Manen, 2016; Moustakas, 1994).

Data Collection Tool

The online semi-structured interview form, used as a data collection tool, was meticulously developed through a comprehensive process based on both quantitative and qualitative research related to cyberbullying. Surveys and guides developed by Hinduja & Patchin (2009), Brighi et al. (2012), and Smith et al. (2008) were reviewed to ensure the robustness of the form's content. The purpose of this form is to capture participants' personal or observed experiences and to raise awareness in this field. Each question was carefully crafted to explore these experiences in detail and was administered in a secure and user-friendly online environment. The development process of the semi-structured form adhered to the principles of qualitative data collection and phenomenological research (Creswell, 2013; Patton, 2002; Merriam, 2009).

The form included only essential demographic questions, such as role, age, gender, and school type, to understand participants' profiles. Additional questions aimed to assess participants' awareness and experiences related to cybersecurity without causing discomfort. Feedback was gathered from a cybersecurity specialist and an educational measurement expert to improve the tool's validity, clarity, and ethical integrity. Expert support is considered an essential strategy for ensuring content validity in qualitative research (Guba & Lincoln, 1994; Merriam, 2009), and in this context, feedback from two field experts was sought to verify whether the interview questions adequately covered the area of interest.

The cybersecurity specialist suggested adding the response option "I would not disclose even if it occurred" to the question "Have you or a relative been subjected to a cyber attack/bullying?" to protect participants' privacy and make them feel more comfortable when answering sensitive questions. Additionally, the measurement expert recommended rephrasing the question "Have you experienced cyberbullying?" to a softer and more inclusive form: "Would you like to share any experiences related to cyberbullying or cybersecurity involving yourself or a relative?" This adjustment aimed to collect data in a non-intrusive manner. These expert-informed modifications ensured that the instrument was theoretically sound, ethically appropriate, and effective for collecting meaningful data. The introductory section of the form clearly stated that participation was entirely voluntary, responses would be coded for analysis, no personal information would be collected, and the data would be used solely for academic purposes (Büyüköztürk et al., 2010).

Data Collection Process

The finalized online semi-structured interview form was distributed using a carefully coordinated process designed to ensure both broad and secure access. The survey link was initially shared with district education directors, who then disseminated it to school administrators and teachers across the selected districts. This hierarchical distribution approach leveraged the existing administrative structure to facilitate efficient communication and enhance participation rates. Utilizing an online platform minimized logistical challenges and allowed participants to complete the survey at their convenience, thereby reducing response biases and increasing the overall reliability of the data (Patton, 2002; Creswell, 2013). The digital format also upheld ethical research standards by ensuring participant anonymity and data security, as no personally identifiable information was collected. Given the sensitive topic of cyberbullying, this method created a safe and private environment, enabling participants to share their experiences more openly and comfortably (Merriam, 2009).

Data Analysis of Data

Phenomenological research aims to uncover the lived experiences and meanings of participants, revealing the psychological essence of a phenomenon (Groenewald, 2004). In this study, content analysis was employed to conceptualize data and identify themes that describe the phenomenon. Codes were generated by examining the data, and superordinate categories (themes) were formed by grouping similar codes. Descriptive interpretations were made based on the themes identified. The coding process involved categorizing responses from different groups, such as researcher questions (Q1, Q2), school administrators (A1, A2), and teachers (T1, T2). On the other hand, in order to enhance generalizability, a large sample size was used, with 256 participants from diverse age groups and educational contexts with different experiences and insights. Following ethical guidelines and maintaining participant confidentiality, data were analyzed using phenomenological principles. Inter-rater reliability was calculated, yielding coefficients of 85%, 85.7%, and 84.8%, ensuring the robustness and validity of the identified themes (Creswell & Poth, 2018). This

approach, which considered demographic diversity, provided a comprehensive understanding of cyberbullying and laid a solid foundation for developing educational policies and interventions (Finlay, 2014; Van Manen, 2016; Moustakas, 1994).

Validity and Reliability

Several strategies based on Lincoln and Guba's (1985) framework were carefully implemented to ensure the rigor and trustworthiness of the research. To establish credibility, peer debriefing, expert consultation, and triangulation were utilized. Input from two field experts during the development of research questions ensured scientific validity, while peer debriefing with fellow researchers validated the impartiality and accuracy of codes, themes, and interpretations. Triangulation cross-verified findings with existing literature and alternative data sources.

The evidence chain played a critical role in enhancing the reliability and validity of the study. Each stage, from data collection to analysis, was conducted transparently and systematically. Contextual justifications for the emerging themes were comprehensively articulated (Miles & Huberman, 2014, Tracy,2010). An evidence chain table, created using direct quotes from participants, enriched the contextual depth and validity of the findings (Creswell, 2013). The appendix, specifically Table 2, clearly illustrated the relationship between the findings and the source data, enabling readers to understand the analytical process better. This structured evidence chain justified how themes were linked to specific findings, reinforcing the transparency and reliability of the analysis (Patton, 2002). On the other hand, transferability was addressed through thick description, offering detailed context and participant experiences, which allows others to assess the applicability of the findings. Dependability was reinforced through an inquiry audit by an experienced academic, ensuring consistency in methods and findings. An audit trail documented all analytical decisions from initial coding to theme development, providing a clear, replicable account of the analysis process. Confirmability was further ensured through reflexivity, where researchers critically examined their biases and their potential impact on the study. Collectively, these measures significantly contributed to the study's validity and reliability.

FINDINGS

The findings of the research regarding the demographic data of the participants and the descriptive analyzes regarding the questions sought to be answered with sub-purposes are summarized under two separate titles below.

Demographic Findings

The study group of the research was determined by appropriate sampling method among school administrators and teachers working in schools affiliated with the Ministry of Education in the central districts of Ankara. The participants who filled out the data collection tool on a voluntary basis and whose data were evaluated are 192 teachers and 64 school administrators from 9 central districts of Ankara (See Table 1). In the study, which included a total of 256 participants, the majority of participants were from secondary schools (n=97), while a similar number of participants were from primary schools (n=81) and high schools (n=78). It is seen that the number of female participants (n=180) is higher than that of men (n=76), and the districts with the highest participation are Pursaklar (n=58) and Çankaya (n=46).

Descriptive Findings

In the findings section of the research, descriptive statistics related to the answers given by the participants in the study group to the research sub-aims are presented. Additionally, selected expressions that emerged through content analysis are included to provide deeper insight. Direct quotes from participants, which support the formation of themes and serve as an evidence chain, are presented in Table 2, which is included in the appendix of the study.

Findings for Research Question 1

According to the first aim of the research, participants share various examples of their own or their acquaintances' experiences with cyber attacks and bullying. T3 states, "A parent's child was defrauded through an online gaming platform," illustrating incidents of fraud in gaming environments. T5 describes, "My Dad's salary account was hacked and they stole the money" highlighting the financial and security impact of such attacks. A8 mentions, "One of our students told us they were defrauded by a fake bank message," recounting a direct experience of fraud. T27 shares, "When I was student in university, My own account was hacked, and offensive content was sent to my friends" emphasizing the personal and social consequences of account hacking. A28 says, "A student's social media profile was stolen, and they were threatened," pointing out the impact of social media threats. T48 explains, "My daughter's social media account was hacked, and her private photos were posted," providing a concrete example of how cyberattacks affect families. A45 notes, "A student's photos were leaked online, and it deeply affected them," highlighting the psychological impact of cyberbullying. T66 states, "It has become common for students' accounts to be hacked and for them to receive threatening messages," indicating the prevalence of account hacking. T33 adds, " My close friend private video was hacked from phone. She lived many bad things socially" and A22 describes, "A student's social media account was hacked, and private information was shared," detailing a case of compromised account and life security.

The findings related to the first aim of the research reveal that participants shared detailed accounts of their own or their acquaintances' experiences with cyberattacks and bullying.These examples underscore the widespread and serious social, psychological, and financial impacts of cyberbullying.

Findings for Research Question 2

According to the second aim of the research, participants detail the various effects of cyberbullying and cybersecurity issues on victims through different examples. A82 shares, "One of my students reported being blackmailed for money," highlighting how cyber threats create fear and helplessness among students. T83 states, "Students are threatened and forced to do things against their will," emphasizing the manipulative nature of such bullying. A84 mentions, "My daughter was blackmailed with the threat of having her photos released," illustrating how personal and familial boundaries are violated by cyber threats. T85 explains, "Students are frightened by threats that their social media accounts will be hacked," pointing out the constant worry caused by security concerns. A86 says, "A student had to seek psychological support after being blackmailed with private information," underscoring the emotional trauma inflicted by such incidents. T87 describes, "Blackmail cases create a significant fear among students," highlighting the widespread anxiety caused by cyberbullying.

A88 notes, "One student was continuously threatened with the misuse of their private information," pointing out the persistent stress that victims face. T89 adds, "Classmates use blackmail to put each other in difficult situations," indicating how cyberbullying affects peer relationships. A90 states, "Social media blackmail severely undermines students' confidence," emphasizing the loss of trust and self-assurance. T91 explains, "One of our students was forced to comply with demands due to threats," demonstrating how threats restrict personal freedom. A102 shares, *"A student said they received threatening messages and were too scared to attend classes,"* pointing out the impact on academic life. T103 mentions, *"Threatening messages create a sense of insecurity in students' social circles,"* showing how bullying erodes trust among peers. A104 says, *"We have students who receive malicious threats over social media,"* illustrating the prevalence of such incidents. T105 describes, *"A student told us they didn't want to come to school because they were being threatened by classmates,"* showing how threats affect school attendance. A106 states, *"As school administrators, we take immediate action when students report being threatened,"* highlighting the need for preventive measures. T107 explains, *"Sending threatening messages to each other is quite common among students,"* demonstrating the normalcy of such behaviors. A108 notes, *"One of our students reported receiving severe threats while playing an online game,"* indicating that threats occur in various digital settings. T109 shares, *"Online threats damage students' social relationships and sense of security,"* illustrating the broader impact on social well-being.

A122 describes, "There are students who constantly apply psychological pressure on others, deeply affecting the victims," emphasizing the long-lasting emotional wounds caused by psychological violence. *T123 mentions, "A student fell into depression because they were constantly belittled by their peers,"* highlighting the severe impact on mental health. *A124 states, "Psychological violence destroys students' self-esteem and isolates them,"* pointing out the sense of loneliness and loss of confidence. *T125 explains, "One student doesn't want to participate in class because they are constantly made fun of,"* illustrating how psychological bullying affects academic engagement. *A126 notes, "Insults and belittlement cause lasting trauma for students,"* emphasizing the enduring effects of such behavior. *T127 says, "A group of friends continuously excludes one student, making them feel worthless,"* drawing attention to the social isolation aspect of bullying. *A128 describes, "Psychological pressure has become a significant source of stress for young people,"* pointing out the impact on emotional well-being. *T129 explains, "Students feel insecure because of the psychological violence they face on digital platforms,"* highlighting how bullying erodes a sense of safety.

The findings related to the second aim of the research provide detailed descriptions of the psychological and physical effects of cyberbullying on victims. Participants reported that cyberbullying can result in severe emotional trauma, as well as physical symptoms such as headaches, stomach pain, and even the need for hospital visits. While the long-term impacts may not be fully understood or easily interpreted, the evidence clearly indicates that cyberbullying leads to significant emotional and social problems. Victims often struggle with a loss of self-confidence, feelings of exclusion, and ongoing emotional distress.

Findings for Research Question 3

In the third sub-objective of the research, descriptive statistics were created regarding the question "How do school administrators and teachers interpret the age group and gender most exposed to cyberbullying?" In this context, Figure 1 and 2 created from the data obtained according to the participants' answers, are shown below.

The figure 1 reflects the perceptions of school administrators and teachers regarding which gender is most likely to be exposed to cyberbullying. A significant portion of both school administrators and teachers believe that females are more frequently targeted by cyberbullying. Specifically, 55% (105 individuals) of school administrators and 56% (36 individuals) of teachers share this view, indicating a higher perceived risk for females. In contrast, the percentage of those who think males are more likely to be victims is relatively low, with only 14% (27 individuals) of school administrators and 8% (5 individuals) of teachers holding this belief. Additionally, there is a noteworthy proportion of respondents in both groups who are uncertain or unable to determine which gender is more susceptible to cyberbullying. Among school administrators, 31% (59 individuals) and 36% (23 individuals) of teachers expressed uncertainty, suggesting that forming a definitive judgment based on the available information is challenging or that they may lack sufficient data to confidently assess the gender most at risk.
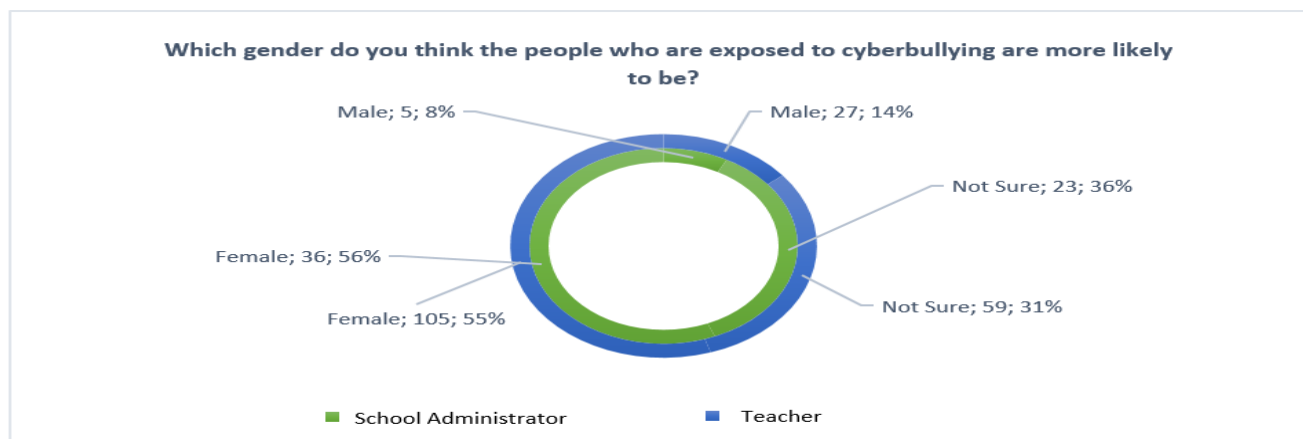
Figure 1. Participants' Perceptions Regarding the Gender Most Exposed to Cyberbullying

Figure 2 highlights the perceptions of teachers and school administrators regarding the age groups most susceptible to cyberbullying. The analysis reveals a shared view that adolescents, particularly those aged 14-18, are at the highest risk, with 101 teachers and 37 school administrators identifying this age range as the most vulnerable. The 11-14 age group is also considered at significant risk, noted by 77 teachers and 24 school administrators, indicating heightened concern for early adolescents. Conversely, the 7-11 age group is perceived as having minimal exposure to cyberbullying, with only 13 teachers and 3 school administrators indicating concern for this age range. These findings suggest a consensus that the risk of cyberbullying increases with age, emphasizing the need for targeted prevention and intervention strategies for older adolescents while acknowledging the potential under-recognition of risks for younger children.

Figure 2. Participants' perceptions of the age group exposed to cyberbullying
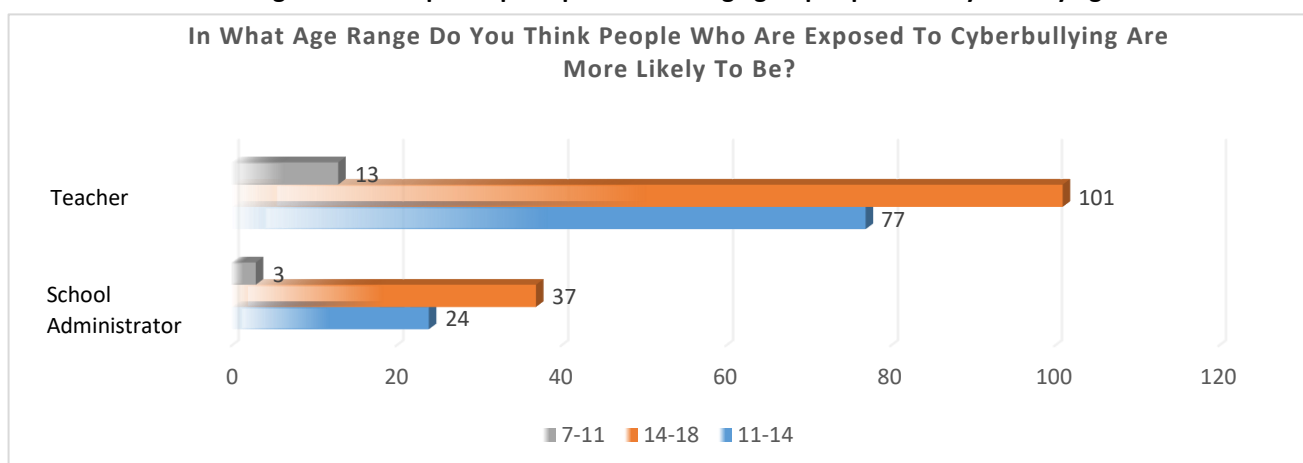
Findings for Research Question 4

The last sub-objective of the research was "What are the themes and sub-themes that emerge according to the cyberbullying experiences of school administrators and teachers?". As a result of synthesizing the codes emerging from the research on the question, it is seen that 7 theme headings were formed as verbal insult (n=31), violation of privacy (n=30), hacking (n=29) threatening (n=27), blackmail (27), fraud (n=22), psychological violence (n=21). While determining the themes during the data analysis phase, the experience codes regarding the participant comments taken into account when including the codes in the theme headings according to the participants' frequency. Some of the experiences shared by some participants were relevant to more than one theme at the same time. For example, T33's statement "My best friend's private video was hacked from her phone. She went through a lot of bad things socially" was included in the chain of evidence table in the themes of hacking and invasion of privacy. at the same time, T33's statement "my best friend went through a lot of trouble when her private video was stolen from her phone. she socially withdrew from society. After her video went viral, she received inappropriate offers and threats. He had a lot of psychological problems. She started to receive psychological support." The statement also concerned threats and psychological violence. Another example was shared by participant T166 "A student was threatened that embarrassing photos would be spread throughout the school. She was ashamed and afraid. That's why she needed psychological support. This is a huge negative social impact for children and young people in the country." This information pointed to the theme of hacking in addition to threats and psychological violence. The other example is A27's sharing. Since the statements were "I was forced to do favors

for someone, or they would share private screenshots. I was very scary and nervous. It took long time to heal. I couldn't tell to my family", this was included under the theme of blackmail and psychological violence. Finally T129 statements can given as an example both verbal insult and psychological violence themes such as "Hurtful comments were made about a student's family. We know that hurtful comments about his family have a psychological effect on him. We understood that he felt excluded. He preferred to be quiet and stand on the sidelines."

Figure 3. Sub-themes of Cyberbullying

In Figure 3, the size of the shapes varies based on the frequency of the seven themes. The details of these themes are further explained through the direct quotes provided in the *Appendix*. A summary of the frequency of codes that form these themes is presented below:

1.Verbal Insult: There are quotes that include the concepts of swearing, verbal abuse, and provocation, which we have included under the theme of Verbal Insult. The Verbal Insult theme, mentioned n=31 times (A14, A2,A16, A18, A20, A26,T124 ,T125 ,T127 ,T128 ,T129 ,T133 ,T134 ,T136 ,T137 ,T138 ,T139 ,T116 ,T117 ,T13 ,T130 ,T14 ,T140 ,T141 ,T148 ,T149 ,T150) illustrates how online platforms are used to deliver abusive language, threats, and provocations. The relatively high frequency of this theme indicates that verbal abuse remains a persistent problem in digital spaces, affecting students' emotional stability and social relationships. This reinforces the findings about the psychological toll of cyberbullying, as victims often face ongoing harassment that undermines their confidence and sense of security.

2.Violation of Privacy: The theme of *Violation of Privacy* encompasses concepts such as taking photos or videos of a person's private parts without their consent and sexual harassment. Violation of Privacy, referenced n=30 times(A58, A1, A10, A17, A19, A21, T1, T33, T80, T78, T83, T93, T94, T105, T106, T102, T10, T100, T101, T132, T107, T108, T111, T112, T114, T120, T121, T122, T123, T166), emphasizes the serious consequences of having personal information or images shared without consent. The frequent mention of this theme reflects the psychological trauma and long-term impact experienced by victims, particularly when intimate or sensitive content is involved. This theme aligns closely with findings that indicate a heightened risk for females, reinforcing the need for gender-sensitive approaches to prevention and intervention.

3.Hacking: We have included the concepts of Social Media Account Stealing, Unauthorized Acquisition of Personal Information, and Fake Account under the theme of hacking. The theme of Hacking, with n=29 mentions (A33, A34, A48, A56, A50, A55, T181, T182, T183, T188, T19, T190, T185, T2, T34, T27, T22, T24, T32, T33, T43, T45, T3, T55, T66, T7, T67, T64, T88), underscores the widespread issue of unauthorized access to personal and social media accounts. The high frequency suggests that hacking is not only a threat to personal privacy but also a tool used for subsequent forms of harassment and manipulation, such as sending inappropriate content or impersonating victims to damage their reputations. This theme highlights the need for stronger digital literacy and cybersecurity measures within educational settings.

4.Threatening: Within the research, we have categorized *Threatening* under the themes of exclusion and comments indicating the intent to cause harm. When examining the participants' data, it is evident that their experiences align with the content of this

theme. For instance, the examples shared reflect how threats and harmful comments are used to instill fear, isolate individuals, or suggest malicious intentions, emphasizing the psychological impact of such behavior. The theme of Threatening was cited n=27 times(A32, A3, A30, A35, A36, T173, T175, T176, T177, T179, T164, T165, T166, T167, T171, T187, T189, T184, T186, T191, T192, T51, T21, T31, T33, T42, T46), reflecting the use of digital platforms to intimidate and isolate individuals through exclusion and threats of harm. The frequency of this theme demonstrates how pervasive and damaging such threats can be, affecting victims' willingness to participate in social and academic activities. The impact on victims' psychological well-being is profound, as constant fear and anxiety disrupt their daily lives and academic performance.

5.Blackmail: Within the theme of Blackmail, which involves coercing individuals to comply with demands using personal or sensitive data, numerous participants shared impactful and concerning experiences. For instance, some reported that private data, such as personal or family information, had been exploited to issue threats or demands, while others detailed incidents where compromising photographs were used to exert pressure. Blackmail, with n=27 (A23, A24, A27, A28, A29, A31, T15, T143, T144, T145, T146, T152, T151, T155, T156, T157, T174, T178, T168, T169, T160, T161, T163, T170, T18, T180, T17) occurrences, highlights the coercive tactics used to force victims into compliance by exploiting their personal data or images. The prevalence of blackmail cases suggests that students are particularly vulnerable to this form of manipulation, which can lead to severe psychological consequences, including anxiety, fear, and helplessness. This theme underscores the need for educational policies that address both prevention and support for victims.

6.Fraud: Within the theme of *Fraud*, we considered the concepts of Asking for Money and Transferring Money to an Account Without Authorization. Fraud was one of the most frequently mentioned themes, with a frequency of n=22 (A13, A11, A15, A22, T103, T104, T126, T135, T109, T110, T113, T11, T118, T119, T147, T142, T153, T158, T154, T159, T162, T172) indicating that financial scams and unauthorized money transfers are critical issues that impact both the digital safety of students and the emotional well-being of those affected. Participants described experiences involving fraudulent messages and impersonation schemes that lead to significant distress and financial loss.

7. Psychological Violence: In the research, the theme of Psychological Violence encompasses the codes of Humiliation, Ridicule, and Exclusion, supported by participants' views. Psychological Violence, with n=21 mentions (A17, A27, T101, T142, T143, T144, T145, T146, T147, T148, T166, T190, T191, T192, T32, T127, T33, T34, T49, T99, T129), points to experiences of humiliation, ridicule, and social exclusion. Although it had a slightly lower frequency among other themes, psychological violence can cause long-lasting emotional scars. Therefore this theme should continue to be a critical area of concern. Victims often experience a decline in self-esteem, feelings of worthlessness, and social isolation, highlighting the need for a comprehensive approach that includes mental health support and awareness programs.

DISCUSSION

This study utilized a phenomenological approach, a qualitative research method focused on exploring individual experiences to reveal the essence of a phenomenon (Groenewald, 2004). Through content analysis of school administrators' and teachers' responses gathered via a structured information form, the research aimed to address cyber psychology awareness and the challenges faced in cyberspace. Among the 255 participants—comprising 192 teachers and 64 school administrators—78% were unaware of Turkey's National Cyber Security Strategy, while 21% had only superficial knowledge of it. The literature indicates a lack of prior research on awareness of this national strategy. Muniandy, Muniandy and Samsudini (2017) argue that enhancing understanding of cyber threats requires collaborative efforts among stakeholders. While some experts question the efficacy of cybersecurity education (Schneier, 2014), others emphasize its necessity in protecting users from cyber threats (Moore, 2010). Participants underscored the need for greater awareness among educators, administrators, and families. This aligns with Franke and Brynielsson (2014), Machimbarrena et al. (2018), and Rahman, Sairi and Khalid (2020), who stress raising awareness of internet risks among children and adults. Interestingly, several educators in this study hesitated to discuss their cyberbullying experiences, echoing findings from Patchin and Hinduja (2012) that suggest reluctance among young individuals to share such experiences. Additionally, 55% of participants indicated that women were more frequently victims of cyberbullying, a finding consistent with Erbiçer (2020) and Şener, Arıkan and Direkçi (2022), though it contrasts with research suggesting greater male victimization (Taştekin & Bayhan, 2018).

The study also identified the significant psychological and physical impacts of cyberbullying, consistent with prior research (Arıcak et al., 2008; Edward, Kontostathis & Fisher, 2016; Patchin & Hinduja, 2006; Şahin, 2012). Documented effects include emotional distress, school absenteeism, academic struggles, and even suicidal ideation. Akbıyık and Kestel (2016) highlighted how victims experience fear, anger, and anxiety, which strain familial and social relationships. Although the sample size and purposeful selection of educators allowed for in-depth exploration, the findings may not be fully generalizable across broader educational contexts due to cultural and socio-economic variations (Kowalski, Limber, & Agatston, 2012). Additionally, the study's cross-sectional nature offers only a snapshot in time. Slonje and Smith (2010) recommend longitudinal research to track how these issues evolve and influence student well-being. Future research could benefit from more diverse samples and employing

triangulation methods to mitigate interpretive subjectivity (Frechette et al.2020). Despite these limitations, this study lays a crucial foundation for understanding cyberbullying dynamics and points to areas needing further investigation.

CONCLUSION AND RECOMMENDATIONS

As indicated in the studies referenced in the discussion section, our research findings align with similar investigations in highlighting the significance of the fourth objective, which addresses the adverse effects of cyberbullying on students' psychological and social well-being at an international level. The risks posed by digital threats to students' developmental processes underscore the necessity of implementing preventive measures. Data derived from participants' experiences illustrate the multifaceted impact of cyberbullying, encompassing themes such as fraud, hacking, violation of privacy, verbal insults, blackmail, threatening behavior, and psychological violence. Moreover, the findings reveal the particular vulnerability of young people to online threats and highlight deficiencies in digital security awareness and ethical online behavior.

The research identifies adolescents aged 14-18 and female students as the most at-risk groups, with prevalent forms of cyberbullying leading to long-term psychological and social consequences. Several critical recommendations emerge from these findings. First, a collaborative, school-based approach that includes teachers, parents, peers, and government entities is essential for protecting children from cybercrime and cyberbullying. Integrating comprehensive cybersecurity and digital ethics education into school curricula is crucial. Second, partnerships should be established between governmental ministries, media organizations, and non-governmental organizations to address informational gaps among educators and families regarding cyber psychology, technological security issues, and the harmful effects of cyberbullying. Additionally, there is a need for increased scientific and academic research on cybersecurity in Turkey and for strengthening legal frameworks to provide robust institutional and legislative support. Utilizing mixed research methods to analyze psychometric data collected from families and students can yield deeper insights into the psychological impact of cyberbullying. Furthermore, regular data analysis using checklists developed by field experts should be conducted to identify cyberbullying tendencies in schools effectively. Given the growing importance of cybersecurity and cyber psychology, establishing and expanding undergraduate programs in cyber psychology is also crucial. Such initiatives will equip societies with well-trained professionals to address these challenges and emphasize the need for comprehensive, forward-thinking educational strategies.

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Statements of publication ethics

I/We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

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

Ethics Committee Approval Information

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Appendix I

Table 2. Expanded Chain of Evidence

Themes	School Administrator	Teacher	The Direct Quotes
1.Fraud (n=22) Asking for money, Transferring Money to Account Without Authorization	A13, A11, A15, A22	T103, T104, T126, T135, T109, T110, T113, T11, T118, T119, T147, T142, T153, T158, T154, T159, T162, T172	A13 described, *"Tricking people to join something by force."* A11 shared, *"I have fraud from my neighbours."* A15 mentioned, *"A male impersonating a different profile to trick female students."* A22 recounted, *"Students engaging with strangers on social media and being tricked."* T103 provided an example, *"One of my students was pressured to pay for a game they didn't even play."* T104 noted, *"Our students have faced scams on social media."* T126 reported, *"Email accounts were hacked."* T135 pointed out, *"During online classes, some students were financially scammed."* T109 detailed, *"Clicking on links in messages led to scams."* T11 explained, *"Pretended to be a friend in messages to get them to click on links."* T118 remarked, *"People are pressured into conforming to beauty standards."* T119 described, *"My friend's Instagram account was hacked, and messages were sent in their name asking for money."* T147 reported, *"Social media accounts were taken over."* T142 shared, *"My social accounts were stolen. I faced scams on social media."* T153 described, *"Children of my acquaintances were pressured through online games."* T154 narrated, *"A phone number was cloned, and the line was used without permission."* T159 revealed, *"Parents reported financial scams during online lessons."* T162 mentioned, *"A 10-year-old boy received inappropriate messages through Instagram."* Finally, T172 spoke of, *"A friend's private account content was misused."*
2.Hacking (n=29) Account Stealing, Acquisition of Personal Information, Fake Account	A33, A34, A48, A56, A50, A55	T181, T182, T183, T188, T19, T190, T185, T2, T34, T27, T22, T24, T32, T33, T43, T45, T3, T55, T66, T7, T67, T64, T88	A33 shared, *"Our school database was accessed without permission."* A34 recounted, *"Emails were hacked, and sensitive information was leaked."* A48 mentioned, *"I was a victim of hacking, and my account was used to spread false information."* A56 stated, *"Several students had their social media accounts compromised."* A50 explained, *"A friend's phone was hacked, and messages were sent pretending to be them."* A55 described, *"My banking app was accessed, and transactions were attempted."* T181 reported, *"Our systems were attacked, leading to a data breach."* T182 noted, *"Unauthorized login attempts were frequent in our institution."* T183 mentioned, *"Hackers manipulated the school website to spread misinformation."* T188 shared, *"Someone gained control of my friend's account and posted offensive material."* T19 revealed, *"My account was used by someone else to harass others."* T190 described, *"Phishing emails led to multiple students losing their credentials."* T185 explained, *"The class notes system was hacked and rendered unusable."* T2 reported, *"I received a message saying my personal information was leaked."* T34 stated, *"People were tricked into providing passwords through fake websites."* T27 shared, *"My friend's account was used to promote scams."* T22 mentioned, *"Unauthorized parties accessed and shared my photos."* T24 noted, *"Hackers created fake profiles of our colleagues."* T32 explained, *"My student's email was hacked, and inappropriate content was sent.".* T33 shared "My close friend private video was hacked from phone. She lived many bad things socially ".T43 reported, *"A social media account was taken over and used for spam."* T45 described, *"Hackers posted private conversations publicly."* T3 mentioned, *"Our student's dad's work server was attacked, and they lost all data."* T55 explained, *"My colleague's laptop was hacked during an online class."* T66 shared, *"Hacking groups targeted our school's systems."* T7 stated, *"Someone impersonated me online, causing misunderstandings."* T67 mentioned, *"Hackers sent fake emergency alerts to everyone."* T64 described, *"Private images were accessed and distributed without consent."* . T88 noted, *"Hackers used malicious software to gain access to our devices."*
3.Violation of Privacy (n=30) Private parts without their consent, Sexual Harassment	A58, A1, A10, A17, A19, A21	T1, T33, T80, T78, T83, T93, T94, T105, T106, T102, T10, T100, T101, T132, T107, T108, T111, T112, T114, T120, T121, T122, T123, T166	A58 stated, *"Photos of students were taken without permission and posted online."* A1 described, *"A close friend's private information was leaked on social media."* A10 recounted, *"Sensitive videos were shared publicly, causing immense distress."* A17 explained, *"Gaming platforms have become places where people demand private images."* A19 shared, *"Someone requested personal photos and later distributed them without consent."* A21 noted, *"Teachers' personal information was made public, creating fear."* T80 described, *"Topless photos of students were circulated among strangers."* T78 mentioned, *"Private conversations were made public, causing embarrassment."* .T83 reported, *"Someone took pictures of students in the locker room without consent."* T93 stated, *"Hacked accounts were used to expose personal messages."* T94 shared, *"Girls were blackmailed with their own photos."* T105 noted, *"A student was threatened with a video taken secretly."* T106 recounted, *"Explicit images were sent to me without consent."* T102 explained, *"Private documents of my neigbour were accessed and used to harass them."*. T1 stated, *"My private information was displayed online after my account was hacked."* T10 mentioned, *"Unauthorized sharing of my images led to severe anxiety."* T100 reported, *"A student group posted private pictures on a social platform.",* T33 adds, " My close friend private video was hacked from phone. She lived many bad things socially" T101 described, *"A family's private life was exposed online, causing humiliation."* T132 stated, *"My student's diary entries were published on the internet without her knowledge."* T107 shared, *"Someone accessed our school records and shared grades publicly."* T108 noted, *"My address and phone number were leaked."* T111 explained, *"Private photos of*

			students were edited and distributed." T112 described, *"A student was harassed with private details of their home life."* T114 shared, "Social media was used to expose secrets between my students." T120 noted, "Our teachers' confidential files were accessed and shared widely." T121 mentioned, "Private pictures of my relative were manipulated and used for cyberbullying." T122 described, "Messages containing private information were spread without consent several times". T123 stated, "Someone hacked into my account and shared personal information without permission." T166 recounted, ""A student was threatened that embarrassing photos would be spread throughout the school. He was ashamed and afraid. That's why he needed psychological support. This is a huge negative social impact for children in the country."
4.Verbal Insult (n=31) Swearing, Verbal abuse, Provocation	A14, A2, A16, A18, A20, A26	T124, T125, T127, T128, T129, T133, T134, T136, T137, T138, T139, T116, T117, T13, T130, T14, T140, T141, T148, T149, T150	A14 shared, "My students often use offensive language towards each other in the classroom, and it goes to the social media sharings and sometimes among teacher groups on social media". A2 stated, "Verbal abuse has become a daily issue among my students and We hear that students continue their activities in groups they have established among themselves." A16 mentioned, "I witnessed students provoking each other with harsh words online." A18 explained, "My son has been insulted multiple times through social media." A20 described, "Online platforms are full of verbal harassment and derogatory comments." A26 noted, "Even teachers are not spared online platforms from verbal attacks like students" T124 recounted, "A student was called derogatory names and made fun of for their appearance." T125 shared, "Even chat groups are filled with offensive and degrading language." T127 stated, "Online insults are often used to intimidate classmates." T128 explained, "Verbal harassment escalates to bullying quickly." T129 described, "Hurtful comments in class and chat group were made about a student's family. We know these have a psychological effect on him. We understood that he felt excluded. He preferred to be quiet and stand on the sidelines." T133 mentioned, "In chat group, I was mocked for my academic performance." T134 reported, "Offensive words were used to humiliate students during online classes." T136 shared, "Teasing and name-calling have caused emotional distress for many." T137 noted, "I heard students using derogatory language towards teachers in chat groups." T138 stated, "A classmate made fun of another student's disability on social media. Human can be unmerciful." T139 explained, "Verbal insults are so common that students feel unsafe." T116 described, "My friends and I have been threatened and insulted repeatedly via chat." T117 reported, "A teacher was verbally abused by students online." T13 mentioned, "I was called names that hurt my self-esteem." T130 stated, "Hateful language was used to attack a student's gender identity." T14 explained, "A student was ridiculed in chat group. The family came to the school,complained to the administration. ." T140 described, "Public online shaming and verbal insults have led to fights in school." T141 noted, "Swearing is rampant in our chat groups." T148 mentioned, "Online argument turned into a stream of insults and threats." T149 reported, "Students use profane language to express anger in online groups." T150 shared, "Verbal harassment on social media in our school is a serious issue"
5.Blackmail (27) S/he is forced to do whatever he wants with the data s/he has	A23, A24, A27, A28, A29, A31	T15, T143, T144, T145, T146, T152, T151, T155, T156, T157, T174, T178, T168, T169, T160, T161, T163, T170, T18, T180, T17	A23 shared, "Someone threatened to release private photos if I didn't comply with their demands." A24 stated, "My friend was blackmailed with messages revealing secrets they wanted to keep hidden." A27 recounted, "I was forced to do favors for someone, or they would share private screenshots. I was very scary and nervous. It took long time to heal. I couldn't tell to my family". A28 explained, "A student was blackmailed into sending money through threats." A29 mentioned, "People use blackmail to manipulate others into doing what they want." A31 described, "Photos were edited to make them look compromising and used to blackmail me." T15 stated, "A student was coerced into sharing exam answers under threat." T143 noted, "A hacker threatened to expose private conversations if we didn't pay." T144 recounted, "Girls in our class were blackmailed with fake, compromising photos." T145 explained, "Someone used a deepfake video to blackmail my friend." T146 shared, "I had to obey demands because they had evidence of a personal matter." T152 described, "A boy was blackmailed into sharing money after private details were exposed." T151 mentioned, "Photos stolen from a hacked account were used to threaten someone." T155 stated, "A girl was forced to send more private pictures to avoid public exposure." T156 explained, "Blackmail through social media is common; even teachers have been affected." T157 noted, "A student had to withdraw from sports because of blackmail threats." T174 shared, "Threats involving personal secrets have become a way to gain power over others." T178 described, "Someone threatened to reveal confidential medical records." T168 explained, "A group of boys blackmailed a classmate into doing their assignments." T169 stated, "They use personal information from hacked accounts to demand money." T160 shared, "Threats about posting private messages publicly were used to intimidate." T161 noted, "I was blackmailed with a fabricated story that could ruin my reputation." T163 mentioned, "Someone recorded a private conversation and used it to make demands." T170 described, "Financial blackmail is becoming a growing problem in our school." T18 stated, "My student was forced into doing errands for others to keep their secret safe." Finally, T180 shared, "A teacher's private life was exploited through blackmail by students." T17 explained, "Hacked information was used to manipulate my decisions."

6.Threatening (n=27) Exclusion, Comments indicating that he/she will do evil,	A32, A3, A30, A35, A36	T173, T175, T176, T177, T179, T164, T165, T166, T167, T171, T187, T189, T184, T186, T191, T192, T51, T21, T31, T33, T42, T46	A32 described, "I was threatened online with messages saying they would ruin my reputation." A3 stated, "Threats of physical violence were made towards my friend if they didn't comply." A30 recounted, "Someone threatened to expose my private conversations to everyone." A35 explained, "I received messages saying I would be harmed if I didn't follow their instructions." A36 mentioned, "Students use threats to intimidate each other into doing things they don't want to." T173 shared, "A student was excluded from all social groups and threatened with worse if they told anyone." T175 stated, "Someone threatened to share secrets if they weren't given money." T176 noted, "Boys in my class threatened a girl if she didn't stop talking to certain friends." T177 explained, "There were threats of failing grades if someone didn't provide answers on a test." T179 described, "Threatening messages about being physically harmed were sent to a student." T164 shared, "My principal was threatened with harm if they reported a student's behavior." T165 noted, "A student threatened to damage school property as revenge." T166 recounted, ""A student was threatened that embarrassing photos would be spread throughout the school. He was ashamed and afraid. That's why he needed psychological support.This is a huge negative social impact for people in the country." T167 explained, "Someone said they would make life unbearable for another student if they didn't leave a group chat." T171 described, "Threats about harming family members were used to control students." T187 stated, "Our teacher received anonymous threats through email." T189 shared, "I heard a student say they would attack another if they didn't get what they wanted." T184 mentioned, "Threats to spread rumors were made if demands weren't met." T186 explained, "A student was threatened with having all their secrets exposed to teachers." T191 noted, "A student was afraid to come to school because of threats made on social media." T192 shared, "There are a few students in our school. Threats of being expelled from groups were used to isolate students." T51 described, "There were threats to damage personal belongings if someone spoke up." T21 explained, "Threats about hacking into accounts were made to scare people." T31 shared, "A teacher was threatened with lawsuits for disciplining a student." T33 shared" my best friend had a lot of problems with her phone being stolen from her private video. she socially withdrew from society. She received inappropriate proposals and threats after her video went viral. She had a lot of psychological problems. She started to receive psychological support." T42 stated, "Someone threatened to share false information about me.". T46 described, "A student was threatened with expulsion if they didn't stop reporting issues."
7.Psychological Violence (n=21) Humiliation, Ridicule, Exclusion, Pressure	A17, A27	T101, T142, T143, T144, T145, T146, T147, T148, T166, T190, T191, T192, T32, T127, T33, T34, T49, T99, T129	A17 discussed issues related to digital safety among teenagers, emphasizing the risk of exclusion in social settings. A27 recounted, "I was forced to do favors for someone, or they would share private screenshots. I was very scary and nervous. It took long time to heal. I couldn't tell to my family" T101 revealed, ""A family's private life was exposed online, causing humiliation.". T127 stated, "Insults are often used to intimidate classmates." T128 explained, "Verbal harassment escalates to bullying quickly." T129 described, "Hurtful comments were made about a student's family. We know that hurtful comments about his family have a psychological effect on him. We understood that he felt excluded. He preferred to be quiet and stand on the sidelines.". T142 stated, "My social accounts were hacked. Humiliation and threats are more common on social media. Bullying can occur through photo manipulation or publishing altered images to ridicule victims." T143 mentioned, "Social media," referencing cases where exclusion from groups has been observed. T144 described, "A social media account was hacked, and the hacker contacted friends to commit fraud, forcing victims to engage in activities they did not consent to, similar to coercion." T145 reported, "The misuse of a hacked social media account often leads to humiliation." T146 said, "The hacking of a social media account can result in severe exclusion from peer groups." T147 noted, "Social media accounts have been seized, which is a form of exclusion from online communities." T148 explained, "There are many seemingly innocent dangers on social media, in SMS messages, and in internet advertisements. People of all ages who lack adequate information and life experience can easily fall victim to this bullying, often involving humiliation or exclusion. Unfortunately, it is harder to provide a solution than to prevent it beforehand. People need to be informed before they are exposed." T166 recounted, ""A student was threatened that embarrassing photos would be spread throughout the school. He was ashamed and afraid. That's why he needed psychological support. This is a huge negative social impact for people in the country.". T190 remarked, "Insults and threats can lead to humiliation." T191 shared, "My student was blackmailed and threatened after their private images were shared on social media, causing significant humiliation.". T192 shared, "There are a few students in our school. Threats of being expelled from groups were used to isolate students." T32 stated, "Students can use each other's photos for threats, which creates fear and humiliation." T33 shared" my best friend had a lot of problems with her phone being stolen from her private video. she socially withdrew from society. She received inappropriate proposals and threats after her video went viral. She had a lot of psychological problems. She started to receive psychological support." T34 said, "A student was threatened and harassed on social platforms, resulting in a sense of exclusion." T49 shared, "I know cases of threats, insults, humiliation, and fraud." T99 noted, "Incidents of insults, threats, and humiliation occur among students, often leading to social exclusion."

| Research Article / Araştırma Makalesi|

The Effect of Cooperative Learning Activities on Pre-service Teachers' Attitudes and Cognitive Perceptions towards Environmental Problems

İşbirlikli Öğrenme Etkinliklerinin Öğretmen Adaylarının Çevre Sorunlarına Yönelik Tutumlarına ve Zihinsel Algılarına Etkisi

[1]**Ayten Arslan**

Abstract

Purpose: The aim of this study is to examine the effects of different methods of cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, conceptual knowledge changes and to reveal their cognitive perceptions.

Design/Methodology/Approach: The study group consists of 50 pre-service primary school teachers (30 females and 20 males) studying in the first year of the Department of Primary School Teaching at a state university. An embedded mixed design, one of the mixed research designs, was used in the research. In the quantitative part of the research, a quasi-experimental design without a control group was used. Therefore, the study group consists of two experimental groups, namely Student Teams Achievement Divisions (STAD) and Jigsaw, which are cooperative learning methods. In the qualitative part of the research, phenomenology was used. As data collection tools, the "Attitude Scale towards Environmental Problems (ASEP)," the "Environmental Problems Word Association Test (EPWAT)," and mind maps (MM) prepared by pre-service teachers were used.

Findings: According to the results obtained from the ASEP, it was determined that cooperative learning methods (STAD and Jigsaw) increased the post-test attitude scores of pre-service primary school teachers towards environmental problems compared to the pre-test scores, but this increase was not statistically significant. According to the results obtained from the EPWAT, cooperative learning methods increased pre-service teachers' conceptual knowledge and quality of concepts related to environmental problems. According to the results obtained from MM, it was determined that the pre-service teachers in the groups had perceptions about global environmental problems, types of environmental pollution and preventing environmental problems.

Highlights: It is seen that cooperative learning methods have positive effects on pre-service teachers' conceptual knowledge changes and cognitive perceptions about environmental problems. For this reason, it is emphasized that different methods of cooperative learning should be used in future research on environmental problems.

Öz

Çalışmanın amacı: Bu araştırmanın amacı, işbirlikli öğrenme modelinin farklı yöntemlerinin sınıf öğretmeni adaylarının çevre sorunlarına yönelik tutumlarına, kavramsal bilgi değişimlerine etkisini incelemek ve zihinsel algılarını ortaya koymaktır.

Materyal ve Yöntem: Araştırmanın çalışma grubunu bir devlet üniversitesinin sınıf öğretmenliği anabilim dalı birinci sınıfında öğrenim gören 50 (30 kadın ve 20 erkek) öğretmen adayı oluşturmaktadır. Araştırmada karma araştırma desenlerinden iç içe gömülü karma desen kullanılmıştır. Araştırmanın nicel kısmında kontrol grupsuz yarı deneysel desen kullanılmıştır. Bu nedenle çalışma grubu işbirlikli öğrenme yöntemlerinden Öğrenci Takımları Başarı Bölümleri (ÖTBB) ve Jigsaw olmak üzere iki deney grubundan oluşmaktadır. Araştırmanın nitel kısmında ise fenomenoloji kullanılmıştır. Veri toplama aracı olarak "Çevre Sorunlarına Yönelik Tutum Ölçeği (ÇSTÖ)", "Çevre Sorunları Kelime İlişkilendirme Testi (ÇSKİT)" ve öğretmen adayları tarafından hazırlanan zihin haritaları (ZH) kullanılmıştır.

Bulgular: Araştırmada ÇSTÖ'den elde edilen sonuçlara göre işbirlikli öğrenme yöntemlerinin sınıf öğretmeni adaylarının çevre sorunlarına yönelik son test tutum puanlarını ön test puanlarına göre artırdığı ancak bu artışın istatistiksel olarak anlamlı olmadığı belirlenmiştir. ÇSKİT'den elde edilen sonuçlara göre işbirlikli öğrenme yöntemleri, öğretmen adaylarının çevre sorunlarına ilişkin kavramsal bilgilerinin ve kavramların niteliğinin artmasını sağlamıştır. ZH'den elde edilen sonuçlara göre gruplarda yer alan öğretmen adaylarının küresel çevre sorunlarına, çevre kirlilik türlerine ve çevre sorunlarını önlemeye yönelik algıya sahip oldukları belirlenmiştir.

Önemli Vurgular: İşbirlikli öğrenme yöntemlerinin öğretmen adaylarının çevre sorunlarına yönelik kavramsal bilgi değişimlerine ve zihinsel algılarına olumlu etkilerinin olduğu görülmektedir. Bu nedenle işbirlikli öğrenmenin farklı yöntemlerinin çevre sorunlarına yönelik yapılacak araştırmalarda kullanılması vurgulanmaktadır.

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INTRODUCTION

Humanity has been in constant interaction with the environment in order to sustain its existence and meet its needs since the beginning of its existence on earth. Over time, with the increase in the population on earth, it has spread to large areas and continued this interaction wherever it went. Economic, social, and technological developments that have occurred in order to meet needs have brought along the problem of destruction of the environment and other elements in the environment; in other words, environmental problems.

Environmental problems are described as the deterioration of the natural environment caused by the pollution of the basic physical components of nature, such as air, water, and soil, as a result of improper and excessive use of natural resources (Güler and Çobanoğlu, 1997). Karabıçak and Armağan (2004) stated that people previously had a perception that the world's self-renewal capacity and environmental resources were unlimited. However, this perception turned out to be wrong as people could not meet their needs sufficiently from the environment, consumed resources rapidly, and environmental pollution reached levels that endangered human health. The behaviors that put human beings and the natural world, which is an integral part of human beings, in danger of extinction stem from the fact that people do not sufficiently comprehend the necessity of living in harmony with nature. For this reason, in order for people's sensitivity towards environmental problems to reach the desired levels, it is necessary to develop the necessary knowledge, skills, and attitudes towards the relationship between humans and the environment (Miser, 2010). This situation has led to an increase in the importance of environmental education (Erbasan & Erkol, 2020).

Environmental education is defined as a lifelong interdisciplinary approach that includes environmental problems and aims to create social awareness with knowledge, skills, attitudes, experience, and individual and social responsibilities that will prevent the formation of new problems by working towards the solution of environmental problems (Moseley, 2000). The aim of environmental education is to raise individuals with environmental awareness in order to eliminate environmental problems, provide individuals with the necessary knowledge and skills related to the protection of the environment, and develop positive behaviors and attitudes towards the environment (Deniz, 2014). Erten (2005) defined attitudes towards the environment as "all of the positive or negative attitudes and thoughts of people towards environmentally beneficial behaviors such as fears, anger, restlessness, value judgments, and readiness to solve environmental problems." Therefore, awareness, perceptions, and attitudes towards the environment and environmental problems should be developed from a very young age, and information about the environment should be provided at all levels of education. Atasoy (2019) stated that children's positive attitudes towards the environment begin to take shape in the family, continue to mature in primary and secondary education, and become the basis for the later periods of their lives, and that various characteristics such as the family's socio-cultural environment, socioeconomic status, place of residence, and cultural level also affect their environmental attitudes. In this context, teachers have great duties in raising individuals who are sensitive and conscious about the environment and environmental problems, changing negative behaviors towards the environment, and replacing them with positive, desired behaviors. Training teachers who have sufficient environmental knowledge, high sensitivity, knowledge, and experience to successfully carry out applied and theoretical environmental studies is very important in terms of achieving the purpose of environmental education (Kahyaoğlu & Özgen, 2012). Accordingly, it is important to determine and improve the attitudes of prospective teachers towards environmental problems during their undergraduate years and to investigate their knowledge levels and cognitive perceptions.

The attitudes and perceptions of society towards the environment can be better understood by evaluating their reactions to environmental problems, their level of taking environmental problems seriously, and the level of knowledge they have in their interactions with nature (Ziadat, 2010). In this respect, environmental education should be carried out in a way that can develop awareness, positive behaviors, and attitudes towards the environment in individuals, linked to daily life, from abstract to concrete, and in a permanent way, and strategies, methods, and techniques that will ensure this in teaching environments should be used (Güven, 2013). In the literature, it is stated that the conventional methods used in environmental education are not very successful in eliminating environmental problems; therefore, learning approaches in which students will take an active role in the learning process should be used in environmental education given in schools (Çimen & Yılmaz, 2014; Uyanık, 2016). One of these methods is thought to be the cooperative learning model.

Cooperative learning is a learning approach in which students form small heterogeneous groups to help each other learn in line with a common goal and actively participate in the learning-teaching process (Doymuş, Şimşek, & Şimşek, 2005). Cooperative learning differs from other methods and techniques in that students fulfill the main critical features such as face-to-face interaction, individual responsibility, and positive commitment in heterogeneous groups and contribute to the learning of both themselves and other individuals in the group. In addition, the fact that there are different methods that enable the use of the cooperative learning model in teaching environments (e.g., STAD, Learning Together, Jigsaw, etc.) facilitates the development of attitudes towards environmental problems and the determination of perception and levels of knowledge.

In light of these findings, this study aimed to reveal the effects of different methods of the cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, which are among the most important problems of today, their conceptual knowledge changes, and their cognitive perceptions. In the literature, it has been revealed that pre-service teachers' awareness of environmental problems is low, and this is directly related to their behaviors towards

environmental problems (Ünal, 2021). In addition, there are also research results showing that pre-service teachers have low knowledge levels and misconceptions about environmental problems (Aydemir & Alım, 2022; Durmuş & Kuruyer, 2023; Fettahlıoğlu, 2018; Özyürek et al., 2019; Şeker & Sert, 2022; Yalçın & Yalçın, 2018). In this context, it is thought that the study will contribute to the literature in terms of revealing the perceptions, attitudes, and conceptual knowledge changes of pre-service teachers towards environmental problems. In addition, when the literature is examined, it is seen that different methods and techniques (activity-based teaching, documentary filming activity, argumentation based learning, 5E learning model and mind maps) are used to develop perceptions, attitudes, and knowledge levels towards environmental problems (Aslan & Bulut, 2021; Efe, Yücel, & Efe, 2020; Eroğlu & Yıldırım, 2020; Güleç & Orhan, 2022; Öner, 2022). However, it is seen that the studies using the cooperative learning model are quite limited (Uyanık, 2016). Thus, it is thought that the results of the research will make important contributions to the literature.

In line with the aim of the research, the following research questions were sought to be answered:

1. Is there a significant difference between ASEP pre-test and post-test scores of the group in which STAD method was applied?
2. Is there a significant difference between ASEP pre-test and post-test scores of the group in which Jigsaw method was applied?
3. Is there a significant difference between ASEP pre-test scores of the groups in which STAD and Jigsaw methods were applied?
4. Is there a significant difference between ASEP post-test scores of the groups in which STAD and Jigsaw methods were applied?
5. How did the STAD method affect the conceptual knowledge changes of pre-service primary school teachers towards the concept of environmental problems?
6. How did the Jigsaw method affect the conceptual knowledge changes of pre-service primary school teachers towards the concept of environmental problems?
7. How are the cognitive perceptions of pre-service primary school teachers in the STAD group towards environmental problems?
8. How are the cognitive perceptions of pre-service primary school teachers in the Jigsaw group towards environmental problems?

METHOD

Research Design

In line with the aim of the study, an embedded mixed design, one of the mixed research designs, was used. Embedded mixed design is used when research data are collected and analyzed within traditional quantitative and qualitative designs. For example, the researcher may include a qualitative research design in an experimental study, which is a quantitative research type (Creswell & Plano Clark, 2015). In this context, pretest-posttest quasi-experimental design without a control group was used in the quantitative part of the study. In this design without a control group, the group or groups included in the research are tested before and after the experimental application and the effect of the application is evaluated according to the difference between the pre-tests and post-tests (Sönmez & Alacapınar, 2013). Phenomenology was used in the qualitative part of the study. Phenomenological research is a research design in which the researcher describes the experiences of the individuals participating in the research about a phenomenon in a way to reach the essence of the statements (Creswell, 2014).

Research Group

The study group of the research consists of 50 pre-service teachers (30 females and 20 males) who are enrolled in the first year of the Department of Primary School Teachers at a state university during the 2021-2022 academic year. The research includes two experimental groups. In the first experimental group, the cooperative learning method of Student Teams Achievement Divisions (STAD) was implemented, while in the second experimental group, the Jigsaw method was applied. The first experimental group consist of 22 pre-service teachers (13 females and 9 males), and the second experimental group consist of 28 pre-service teachers (17 females and 11 males). Criterion sampling, one of the purposeful sampling methods, was used in the research. Criterion sampling is a method in which the sample is selected based on specific criteria identified by the researchers (Yıldırım & Şimşek, 2013). In this research, the criterion was defined as pre-service primary school teachers who had taken an environmental education course at the undergraduate level.

Data Collection Tools

In the study, "Attitude Scale towards Environmental Problems (ASEP)," "Word Association Test towards Environmental Problems (EPWAT)," and "Mind Maps on the Concept of Environmental Problems (MM)" prepared by pre-service teachers were used as data collection tools. The ASEP is a 3-point Likert-type scale consisting of 45 items and five factors, developed by Güven (2013). The Cronbach alpha value of the scale was found to be .88. A word association test is a data collection tool that reveals the connections and semantic closeness between concepts in the cognitive structure of individuals by writing a certain number of words that come to mind about the key concepts given for any subject. The order of the words that students respond to the

key concept reveals the connections and semantic relations in their memory for the concept (Bahar & Özatlı, 2003). As in Figure 1, the concept of "Environmental Problems" was written 10 times underneath each other, and a space was left next to them. The pre-service teachers were asked to write the first words that came to their minds when they thought of environmental problems and were given 60 seconds to do so. At the end of the time, the papers were collected. The ASEP and the EPWAT were administered to the pre-service teachers in both groups as a pre-test before starting the experimental application and as a post-test at the end of the application. After the end of the applications, the pre-service teachers were asked to create mind maps with the help of colored pencils by using various branches between the words, shapes, and symbols that came to their minds about the concept of environmental problems. Hence, pre-service teachers' cognitive perceptions of environmental problems will be revealed.

Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

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Environmental Problems, ……………………………………

Environmental Problems, ……………………………………

Figure 1. Environmental problems word association test

Implementation Process

Before starting the implementation process, the pre-service teachers in the experimental groups were given detailed information about the implementation process. Afterwards, the groups were administered the ASEP and the EPWAT as pre-tests. The applications in the groups were carried out as follows:

1. Groups of 4 pre-service teachers were formed in a heterogeneous (students' grade point averages and gender) way in the STAD and Jigsaw groups.

2. Taking into account the principles regarding the application of the cooperative learning methods of STAD and Jigsaw methods, environmental problems were covered for 10 weeks, 2 class hours per week. During the 10-week implementation process, the basic concepts of environmental education and environmental problems, types of environmental pollution, and global environmental problems were covered in the experimental groups under four sub-headings: (1) what it is and how it occurs; (2) what the causes are; (3) what the consequences are; and (4) how to prevent it and the measures to be taken. Within this context, the topics covered in the experimental groups are provided in Table 1.

Table 1. Topics Covered in the Groups

Topics	Topics
Week 1- Basic concepts	Week 6- Acid rain
Week 2- Air pollution	Week 7- Soil pollution
Week 3- Global warming	Week 8- Water pollution
Week 4 - Greenhouse effect	Week 9- Noise pollution
Week 5- Ozon layer	Week 10- Erosion and drought

3. *Implementations in the STAD Group:* Due to the class size, two heterogeneous groups of five and two heterogeneous groups of four were formed. After the groups distributed the tasks among themselves, the implementation started. The implementations started with the lecturer (researcher) explaining the topics. Then, the topic of the relevant week was given to the groups with subheadings, and the group members were asked to study the topic. In this process, the lecturer answered the questions of the pre-service teachers, if any, and provided guidance on the steps of

implementation. After the group members completed their work on the subtopics, midterm exams were held on that week's topic. Then, the scores of the group members from the midterm exams were calculated together, and their individual development scores were determined according to the evaluation criteria of the STAD. Team scores were calculated with the determined individual development scores. Finally, the team with the highest score was rewarded (Açıkgöz, 2009). In the groups, the process progressed in this way every week.

4. *Implementations in the Jigsaw Group:* The topics to be covered each week in the group were divided into four subtopics. Then, four subtopics were distributed to four students in each home group. In this way, seven *Home Groups* were formed. Then each group members in home groups worked on their own subtopics. Due to the nature of the Jigsaw method, each group member first works on his or her own topic, then the members working on the same topic come together to form *Expert Groups*. Accordingly, after the group members worked in the expert groups, each member returned to his/her home group and explained the sub-topic he/she had studied until the other group members learned it. In some weeks, group members of some groups could not attend the lesson for various reasons. In this case, it was ensured that a member of another group explained that subtopic to the group members so that the groups did not miss the topics. After the Jigsaw applications were completed in all groups, questions about the subject were asked to the group members for evaluation purposes. In addition, the lecturer answered the questions of the students, if any, at each stage and provided guidance on the application steps.

5. After the end of the implementations, ASEP and EPWAT were applied as post-tests in the groups. In addition, pre-service teachers were asked to make mind maps about the concept of "environmental problems" in 1 lesson hour. The applications lasted 12 weeks in total, including the application of pre-test and post-test. The implementation process of the research is given in Table 2.

Table 2. Implementation Process

	Pre-Implementation	Implementation		Post-Implementation
Experimental Groups	Pre-Tests	Topics	Method	Post-Tests
Experimental Group 1	ASEP-EPWAT	Topics Covered in Groups	STAD	ASEP-EPWAT-MM
Experimental Group 2	ASEP-EPWAT	Topics Covered in Groups	Jigsaw	ASEP-EPWAT-MM

Data Analysis

Since the research was designed with a mixed design, quantitative and qualitative analysis methods were used. In the analysis of quantitative data, parametric tests and descriptive statistics were used according to the results of the normality assumption. Content analysis was used to analyze qualitative data. In the analysis of the attitude scale, dependent groups t-tests and independent groups t-tests were used to determine whether there was a significant difference between the pre-test and post-test of the groups within and between the groups. Before starting the analysis of the data obtained for the word association test, the response papers of the pre-service teachers in both groups were numbered, and descriptive analysis was performed. In order to analyze the pre-test and post-test results of the groups, the words associated with the key concepts were examined in detail by the researcher and an expert. The aim here was to reveal the misconceptions, lack of knowledge, or words resulting from knowledge errors, if any, of the pre-service teachers about environmental problems. First, individual frequency tables were created by the researcher and the expert. Subsequently, these frequency tables were compared, the data obtained was checked again, and a consensus was reached. Thus, reliability was tried to be ensured. Based on the resulting frequency tables, concept networks were created in order to present the perceptions and conceptual changes of pre-service teachers in a formal way. Bahar et al.'s (1999) breakpoint (BP) technique was used to construct concept networks. Accordingly, in the frequency table, 3-5 words below the most frequently repeated word related to the key concepts in the KIT are considered the breakpoint, and the words above this response frequency are written in the first part of the map (Bahar & Özatlı, 2003). In the study, in order to prevent the concept networks from being too complex, $5 < BP \leq 1$ was not included in the concept network. In the SCM group, the colors for each BP range were expressed in purple for 15 and above, in blue for $15 < BP \leq 10$, and in orange for $10 < BP \leq 5$. In the Jigsaw group, purple for 20 and above, blue for $20 < BP \leq 15$, orange for $15 < BP \leq 10$, and dark blue for $10 < BP \leq 5$. analysis was used to analyze the mind maps. With this aim, the researcher and the expert independently analyzed the mind maps of the pre-service teachers, and codes were created. Then, categories and themes were created individually for the codes. The codes, categories, and themes were checked by the researchers, and comparisons were made. The checks and comparisons regarding codes, categories, and themes continued until a consensus was reached. Finally, tables of codes, categories, and themes were created, and the tables were interpreted.

FINDINGS

The findings obtained from the analysis of the data collected in line with the research questions are provided below.

Findings Obtained from the Environmental Problems Attitude Scale

Before starting the analyses, normality tests were conducted to determine whether the data showed a normal distribution and to identify which tests would be used for analysis. The results of the normality test for the attitude scores of pre-service primary school teachers towards environmental problems are presented in Table 3.

Table 3. Results of the Normality Test for Attitude Scores

Groups	N	Shapiro-Wilks	$\overline{X}$	sd	SS	Skewness	Kurtosis
STAD Pre-Test	22	,760	2,32	22	,159	-,292	,163
STAD Post-Test	22	,383	2,37	22	,139	-,357	1,454
Jigsaw Pre-Test	28	,497	2,37	28	,144	,596	1,441
Jigsaw Post-Test	28	,263	2,41	28	,150	,571	,768

Upon examining Table 3, it was determined that the pre-test and post-test attitude scores of pre-service primary school teachers towards environmental problems in the STAD and Jigsaw groups showed a normal distribution (S-W $_{STAD\ Pre-Test}$ = 0.760, SD = 22, p > .05; S-W$_{STAD\ Post-Test}$ = 0.383, SD = 22, p > .05; S-W$_{Jigsaw\ Pre-Test}$ = 0.497, SD = 28, p > .05; S-W$_{Jigsaw\ Post-Test}$ = 0.263, SD = 28, p > .05). Therefore, the pre-test and post-test scores of the groups were analyzed using parametric tests, specifically the T-Test.

The dependent samples t-test results for the impact of the STAD method on the attitude scores of pre-service teachers towards environmental problems are provided in Table 4.

Table 4. Dependent Samples T-Test Results for Pre-Test and Post-Test Scores with the STAD Method

STAD	N	X	SS	t	sd	p
Pre-Test	22	2,32	,159	-1,339	21	,195
Post-Test	22	2,37	,139			

Upon examining Table 4, it is observed that there is no statistically significant difference between the pre-test and post-test scores of the group where the STAD method was applied (t = -1.339; p > .05). According to this finding, the STAD method did not create any change in the attitudes of pre-service primary school teachers towards environmental problems.

The results of the dependent samples t-test conducted to determine the impact of the Jigsaw method on the attitude scores of pre-service teachers towards environmental problems are presented in Table 5.

Table 5. Dependent Samples T-Test Results for Jigsaw Method Pre-Test and Post-Test Scores

Jigsaw	N	X	SS	t	sd	p
Pre-Test	28	2,3722	,14484	-1,645	27	,112
Post-Test	28	2,4199	,15047			

Upon examining Table 5, it is observed that there is no statistically significant difference between the pre-test and post-test scores of the group where the Jigsaw method was applied (t = -1.645; p > .05). According to this finding, the Jigsaw method did not create any change in the attitudes of pre-service primary school teachers towards environmental problems.

Following these analyses, the results of the independent samples t-test conducted to determine whether there is a significant difference in the attitudes towards environmental problems before the implementation between the STAD and Jigsaw groups are presented in Table 6.

Table 6. Independent Samples T-Test Results for Pre-Test Attitude Scores of STAD and Jigsaw Methods

Groups	N	X	SS	t	sd	p
STAD Pre-Test	22	2,32	,159	-1,151	48	,255

Groups	N	X	SS	t	sd	p
Jigsaw Pre-Test	28	2,37	,144			

Upon examining Table 6, it is determined that there is no significant difference in the pre-test scores between the groups before the implementations (t = -1.151; p > .05). According to this finding, it can be said that the attitude levels of students in the groups towards environmental problems were similar before the implementations.

To determine which method, STAD or Jigsaw, had a greater impact on the attitudes of pre-service teachers towards environmental problems after the implementations, the results of the independent samples t-test are presented in Table 7.

Table 7. Independent Samples T-Test Results for Post-Test Attitude Scores of STAD and Jigsaw Methods

Groups	N	X	SS	t	sd	p
STAD Post Test	22	2,37	,139	-1,147	48	,257
Jigsaw Post Test	28	2,41	,150			

Upon examining Table 7, it is determined that there is no significant difference in the post-test scores between the groups after the implementations (t = -1.147; p > .05). According to this finding, it can be said that neither the STAD nor the Jigsaw method created a significant difference in the attitudes of pre-service teachers towards environmental problems compared to each other after the implementations.

Findings from the Word Association Test Regarding the Concept of Environmental Problems

The findings regarding the impact of the STAD and Jigsaw methods on the conceptual changes of pre-service primary school teachers regarding the concept of "Environmental Problems" are presented in Table 8.

Table 8. Findings from the Word Association Test

	The Most Repeated First Ten Words				Response Word Type		Total Response Word	
	Pre-Test	(f)	Post-Test	(f)	Pre-Test (f)	Post-Test (f)	Pre-Test (f)	Post-Test (f)
STAD	Air pollution	15	Air pollution	16	74	56	193	220
	Soil pollution	12	Water pollution	16				
	Water pollution	11	Global warming	15				
	Noise pollution	10	Soil pollution	13				
	Acid rain	7	Thinning of the ozone layer	12				
	Waste	7	Radioactive pollution	12				
	Unconsciousness	7	Greenhouse effect	12				
	Garbage	7	Noise pollution	12				
	Global warming	6	Acid rain	11				
	Sea pollution	5	Light pollution	9				
Jigsaw	Air pollution	22	Water pollution	24	79	61	242	280
	Water pollution	20	Air pollution	23				
	Soil pollution	16	Soil pollution	21				
	Global warming	12	Erosion	19				
	Acid rain	10	Global warming	19				
	Unplanned urbanization	7	Noise pollution	16				
	Waste	6	Light pollution	14				
	Unconsciousness	6	Thinning of the ozone layer	14				
	Lack of education	6	Acid rain	13				
	Health problems	6	Drought	13				

In Table 8, the variety and number of response words associated with the concept of environmental problems in the pre-test and post-test for the STAD and Jigsaw groups are presented. In the STAD group, before the implementation of STAD, the variety of response words related to environmental problems in the pre-test was 74, with a total of 193 response words. In the post-test, the variety of response words decreased to 56, while the total number of response words increased to 220. For the Jigsaw group, the pre-test exhibited a variety of 79 response words with a total of 242, and in the post-test, the variety decreased to 61, while the total number of response words increased to 280. It was determined that in both groups, all blanks (10 blanks) were filled with meaningful words in the post-tests.

Table 8 provides the most frequently repeated words related to the concept of environmental problems in the STAD and Jigsaw groups. In the STAD group, during the pre-test, the most frequently repeated response words were air pollution (f=15), water pollution (f=12), and soil pollution (f=12), while in the post-test, air pollution (f=16), water pollution (f=16), and global warming (f=15) were determined as the most repeated. In the Jigsaw group, during the pre-test, the most frequently repeated response words were air pollution (f=22), water pollution (f=20), and soil pollution (f=16), while in the post-test, water pollution (f=24), air pollution (f=23), and soil pollution (f=21) were identified as the most repeated. One noteworthy aspect in both groups is that, even though terms related to environmental problems were most frequently repeated in the pre-tests, in the post-tests, fundamental concepts related to global environmental problems and types of environmental pollution were more frequently reiterated instead of terms like ignorance and lack of education. Therefore, it can be concluded that cooperative learning methods positively influenced the conceptual changes of pre-service teachers.

In the figures provided in Table 9, concept networks created from the most frequently repeated response words in the pre-test and post-test of pre-service teachers in the STAD group towards the "environmental problems" concept are presented.

Table 9. Concept Networks Created for Pre-Test and Post-Test of the STAD Group

Cutting Point (CP)	Pre-Test	Post-Test
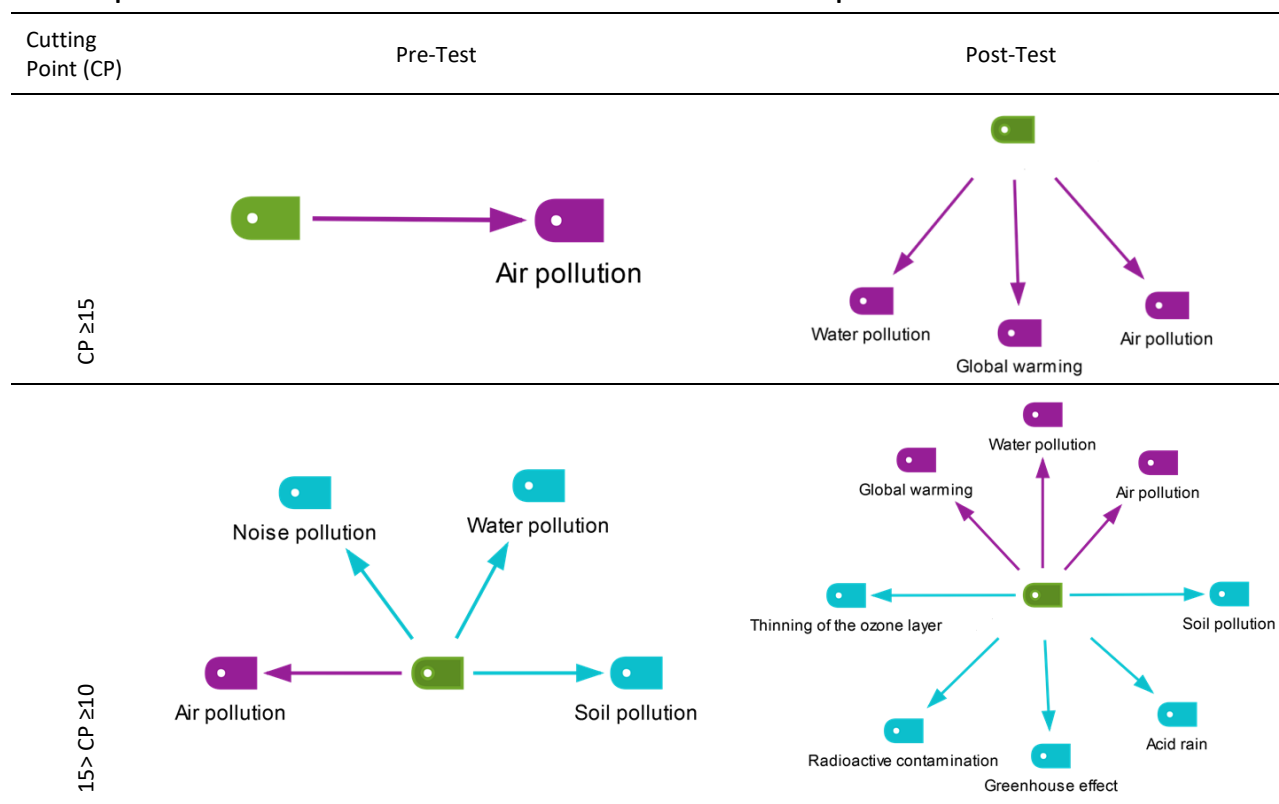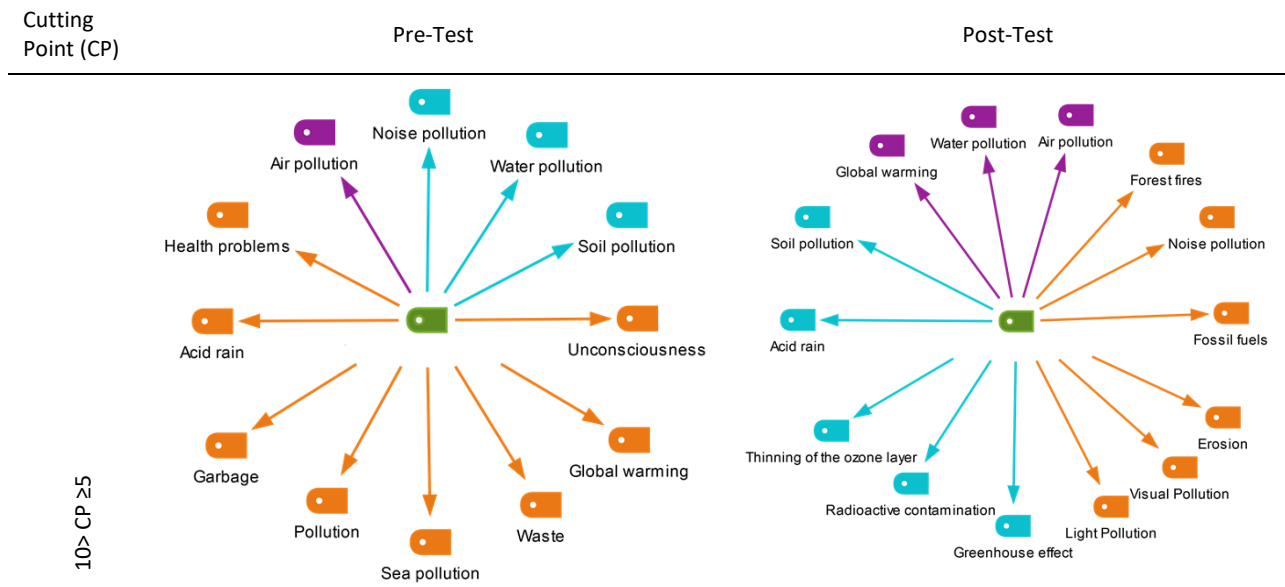
The pre-test findings in Table 9 can be interpreted as follows:

For the breakpoint 15 and above, it is noteworthy that students associated the key concept of environmental problems only with the response word air pollution. Air pollution was the first concept that came to students' minds when environmental problems were mentioned. Since air is a substance shared by everyone in all areas and air pollution is among the most likely types of environmental pollution, it is thought that environmental problems are associated with this response word the most.

For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words soil pollution, water pollution, and noise pollution, respectively. Similarly, it is thought that students associate these words with the key concept of environmental problems since they are the most frequently encountered types of pollution in our environment.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words acid rain, waste, unconsciousness, garbage, global warming, marine pollution, pollution, and health problems, respectively. Although the majority of these words associated with the concept of environmental problems are related to environmental problems, it can be said that they are words that are frequently encountered in daily life and at a superficial knowledge level. Furthermore, it is seen that words related to global environmental problems were encountered for the first time in this range.

The post-test findings in Table 9 can be interpreted as follows:

For breakpoint 15 and above, students associated the key concept of environmental problems with the response words air pollution, water pollution, and global warming. It is noteworthy that one of the words associated with global environmental problems (global warming), which was encountered for the first time in the pre-test between the breakpoint 10<BP≤5, was the first word that came to students' minds and made the most associations when environmental problems were mentioned in this range. In addition, while only one concept emerged in this range in the pre-test, three concepts emerged in this range in the post-test.

For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words soil pollution, ozone depletion, radioactive pollution, greenhouse effect, and acid rain, respectively. What is noteworthy in this range is the emergence of words belonging to different global environmental problems, together with some of the most frequently encountered types of pollution as well as some of the types of environmental pollution that are not always seen (radioactive pollution).

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words light pollution, visual pollution, erosion, fossil fuels, noise pollution, and forest fires, respectively. Among these words associated with the concept of environmental problems, it is possible to say that fossil fuels and forest fires are the most important human resources that cause environmental problems. In addition, when compared to the pre-test, it is seen that words that cause environmental problems, such as unconsciousness and pollution, are not included in this range and that there are more qualified words associated with the sources that cause environmental problems (such as fossil fuels and forest fires). This shows that the quality of the words produced by the students increased with the practices.

In general, when looked at overall, there were no concept misconceptions in both the pre-test and post-test.

Table 10 provides concept networks created from the most repeated response words in the pre-test and post-test of the pre-service teachers in the Jigsaw group towards the concept of environmental problems.

Table 10. Concept Networks Created for the Pre-test and Post-test of the Jigsaw Group

Cutting Point (CP)	Pre-Test	Post-Test
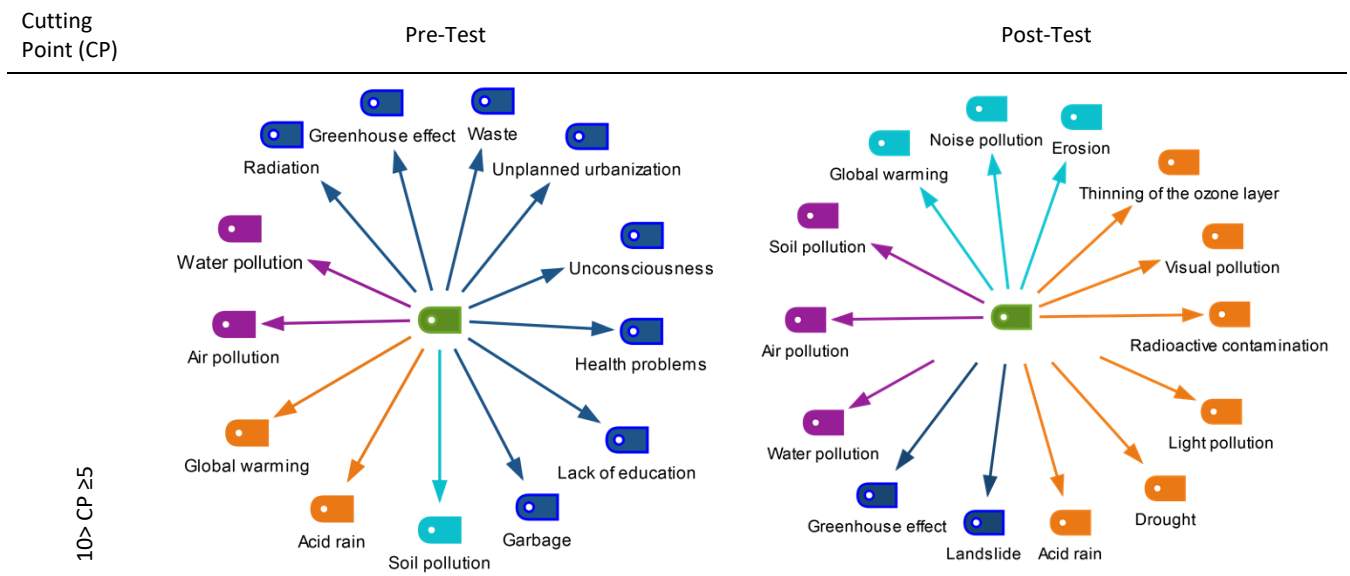
The pre-test findings in Table 10 can be interpreted as follows.

For the breakpoint 20 and above, students associated the key concept of environmental problems with the response words air pollution and water pollution. It can be said that the first words that come to students' minds when environmental problems are mentioned are air pollution and water pollution. Since air and water pollution are the most common environmental problems encountered in daily life, it is thought that these response words emerged the most.

For the breakpoint between 20<BP≤15, students associated the key concept of environmental problems only with the response word soil pollution. It can be said that in this range, students attributed one of the types of environmental pollution that can be heard frequently. It is noteworthy that only one word was produced in this range.

For the breakpoint between 15<BP≤10, in this range, students associated the key concept of environmental problems with the response words global warming and acid rain. It is noteworthy that the words related to global environmental problems appeared for the first time in this range.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words unplanned urbanization, waste, unconsciousness, lack of education, health problems, garbage, radiation, and greenhouse effect, respectively. In this range, it is seen that students mostly produced words related to human resources that can be frequently heard in daily life that cause environmental problems.

The post-test findings in Table 10 can be interpreted as follows.

For the breakpoint 20 and above, students associated the key concept of environmental problems with the response words air pollution, water pollution, and soil pollution, respectively. In this range, it is possible to say that the first words that come to students' minds are the types of environmental pollution, as in the pretest.

For the breakpoint between 20<BP≤15, students associated the key concept of environmental problems with the response words erosion, global warming, and noise pollution, respectively. It is noteworthy that one of the words associated with global environmental problems (global warming), which was encountered for the first time in the pre-test between the breakpoint 15<BP≤10, was the first word that came to students' minds and made the most associations when environmental problems were mentioned in this range. In addition, the number of responses given by the students in this range increased compared to the pretest.

For the breakpoint between 15<BP≤10, students associated the key concept of environmental problems with the response words light pollution, ozone depletion, acid rain, drought, radioactive pollution, and noise pollution, respectively. What is noteworthy in this interval is the emergence of words belonging to different global environmental problems (drought), together with some of the most frequently encountered types of pollution (radioactive pollution) as well as some of the less common types of environmental pollution (radioactive pollution). In addition, when compared to the pretest, there was an increase in the number of words that emerged in the other intervals. This shows that the students gained more knowledge about environmental problems with the practices.

For the breakpoint between 10<BP≤5, students associated the key concept of environmental problems with the response words greenhouse effect and landslide, respectively, in this range. Compared to the pre-test, it was determined that words related to human resources (such as lack of awareness and lack of education) that cause environmental problems were not included in this range. However, it is seen that words related to global environmental problems (such as drought) and different types of environmental pollution that cannot be encountered frequently in daily life (radioactive pollution) have much more

destructive and negative effects in terms of their consequences, although they are not recognized by society. This shows that the quality of the words produced by the students increased with the practices.

In general, when looked at overall, there were no concept misconceptions in both the pre-test and post-test.

Findings Obtained from Mind Maps Regarding the Concept of Environmental Problems

The findings obtained from the analysis of mind maps of the pre-service teachers in the STAD group are presented in Table 11.

Table 11. Mind Maps of the STAD Group

Theme	Category	Code	Frequency (f)
		Acid rain	14
		Global warming	13
		Erosion	10
	Global environmental problems	Thinning of the ozone layer	10
		Drought	7
		Greenhouse effect	6
		Desertification	1
		Water pollution	27
		Air pollution	19
		Noise pollution	18
	Types of environmental pollution	Soil pollution	16
		Visual pollution	9
		Light pollution	5
		Radioactive contamination	6
		Volcanic eruptions	10
		Desert dust	4
		Volcanoes	2
Environmental Problems	Natural causes	Mucus	2
		Water vapor	2
		Floods	1
		Krakatoa	1
		Tambora	1
		Forest fires	16
		Wastes	8
		Exhaust	8
		Exhaust gases	8
		Heavy metals	7
		Garbage	7
		Deodorants	6
		Factory waste	6
	Artificial causes	Gases from factory chimneys	5
		Incorrect agricultural practices	5
		CO_2	4
		Factory chimneys	4
		Factory smoke	4
		Fossil fuels	4
		Use of chemical fertilizers	4
		Perfumes	4
		Excessive volume	3

Theme	Category	Code	Frequency (f)
		CFC	3
		CH_4	3
		CO	3
		Overlighting of skyscrapers	3
		NO_2	3
		Industrialization	3
		Deforestation	2
		Factories	2
		Technological devices	2
		Sewage waters	2
		Urbanization	2
		Horn	2
		Cosmetic products	2
		Population density	2
		Nuclear industry	2
		Sprays	2
		Aircraft noise	2
		Excessive slope	1
		Energy wastage	1
		H_2SO_4	1
		Livestock activities	1
		HCFC	1
		HNO_3	1
		Human	1
		Rural to urban migration	1
		Motor vehicles	1
		Plastics	1
		Temperature increase	1
		SO_2	1
		SO_4	1
		Tanker accidents	1
		Agricultural pesticides	1
		Transportation	1
	Results	Melting of glaciers	3
		Climate change	2
		Polar bears	1
		Historical artifacts	1
	Precautions	Filter	1

In Table 11, it can be seen that the mind maps made by the pre-service teachers in the STAD group were categorized under the theme of "environmental problems" as "global environmental problems," "types of environmental pollution," "natural causes," "artificial causes," "consequences," and "precautions." Among these categories, the codes "acid rain," "global warming," "erosion," and "ozone depletion" came to the fore under the category of "global environmental problems." When the mind maps of the pre-service teachers were examined, it was seen that almost all of these codes were expressed by drawing one-to-one figures related to the code. For example, acid rain was depicted as compounds such as "SO_2", "NO_2", "H2SO4" coming down from dark clouds in the form of raindrops. Under the category of "types of environmental pollution," "water pollution," "air pollution," "noise pollution," and "soil pollution" were the most prominent codes. It is noteworthy that the codes under this category in the mind maps are depicted with details in a way to express the concepts exactly. For example, while expressing the noise pollution code, the figures of loudspeakers, airplanes, megaphones, and the figure of the world plugging its ears to express excessive noise were depicted. While expressing water pollution, the formation of waste on the water surface due to the

discharge of sewage water into the puddle was also depicted. Again, light pollution is depicted in the form of skyscrapers and buildings painted yellow. When the "natural causes" category is analyzed, the code "volcanic eruptions" stands out. While expressing this code, the picture of "Tambora Volcano" was drawn by specifying the specific name. Under the category of "artificial causes," the codes "forest fires," "wastes," "exhaust," and "exhaust gases" were formed. When the artificial causes category was analyzed, it was noteworthy that human-induced situations that cause global environmental problems and environmental pollution types were depicted in a way to create a plot. For example, the exhaust code was illustrated using a figure of gas coming out of a car exhaust. Under the "consequences" category, the codes "melting of glaciers" and "climate change" were formed. It is noteworthy that these codes are among the consequences of global warming and are depicted by drawing an image of melting ice. Finally, under the category of "Precautions," one person expressed the code "filter." The filter code was illustrated with a picture of gas coming out of the factory chimney.

Examples from the mind maps of pre-service teachers related to these codes and themes are given in Figure 2.

Figure 2. Examples from mind maps of the STAD group

Findings from the analysis of mind maps of the pre-service teachers in the Jigsaw group are presented in Table 12.

Table 12. Mind Maps of the Jigsaw Group

Theme	Category	Code	Frequency
Environmental Problems	Global environmental problems	Acid rain	15
		Drought	11
		Global warming	10
		Erosion	9
		Thinning of the ozone layer	7
		Ozone layer	4
		Greenhouse effect	4
	Types of environmental pollution	Air pollution	24
		Noise pollution	24
		Water pollution	18
		Soil pollution	14
		Visual pollution	7
		Radioactive contamination	6
		Light pollution	4
	Natural causes	Volcanic eruptions	7
		Volcanoes	6
		Evaporation of seawater	5
		Desert dust	4
		Landslide	2
		Excessive heat	2
		Flood	1
		Wind	1
		Tsunami	1
		Snow	1
		Sweeping	1
		Avalanche	1
		Scarcity of rainfall	1
	Artificial causes	Forest fires	10
		Garbage	9
		Motor vehicles	8
		Industrialization	8
		Factories	7
		High sound	5
		Exhaust gases	5
		Gases from factory chimneys	5
		CO_2	4
		Deodorants	4
		Factory smoke	4
		Fossil fuels	4
		Coal	4
		Deforestation	4
		Plastics	4
		Cigarette smoke	4
		Solid waste	3
		Waste batteries	3
		Wastes	3
		CH_4	3
		Unplanned urbanization	3
		Factory chimneys	3
		Residence	3

Theme	Category	Code	Frequency
		Fires	3
		NO_2	3
		Nuclear power plants	3
		Perfumes	3
		SO_2	3
		Incorrect agricultural practices	3
		Noise	2
		Slope of lands	2
		Heating methods	2
		Dumping of waste into streams	2
		Exhaust	2
		Exhaust smoke	2
		Chimneys	2
		Animal waste	2
		Factory wastes	2
		Human activities	2
		Use of chemical fertilizers	2
		Urbanization	2
		Irrigation of soil with polluted water	2
		Chemical wastes	2
		Honking	2
		Plastic bag	2
		Tires	2
		Wood	2
		Stove	2
		Plastic bottle	2
		Cigarette butt	2
		Agricultural activities	2
		Airplane noise	2
		UV rays	2
		Carbon	1
		Carbon footprint	1
		Fire	1
		Unconscious consumption	1
		CFC	1
		CO	1
		Lack of education	1
		Phone ringtone	1
		Energy	1
		Sewage waters	1
		Metal cans	1
		Match	1
		N_2O	1
		Radio	1
		Street lamp	1
		Medical wastes	1
		Transportation activities	1

Theme	Category	Code	Frequency
		Toxic substances	1
		Historical artifacts	3
		Climate change	2
		Inefficient agriculture	2
		Inefficient soil	2
		Environmental pollution	2
		Death of fish	1
		Danger	1
		Ice age	1
	Results	Polar regions	1
		Depletion of natural resources	1
		Melting of glaciers	1
		Harm to living beings	1
		Disturbance of the ecosystem	1
		Diseases	1
		Animal deaths	1
		Stress	1
		Poisoning	1
		Skin cancer	1
		Filter	1
	Precautions	Recycling	1
		Mask	1

According to Table 12, the mind maps made by the pre-service teachers in the Jigsaw group were categorized under the theme of "environmental problems" as "global environmental problems," "types of environmental pollution," "natural causes," "artificial causes," "consequences," and "precautions." Among these categories, the codes "acid rain," "drought," "global warming," and "erosion" came to the fore under the category of "global environmental problems." When the mind maps of the pre-service teachers were examined, it was seen that almost all of these codes were expressed by drawing one-to-one figures related to the code. For example, while expressing the drought code, the figures of dried, cracked soil and a single green tree on cracked soil were used. Under the category of "types of environmental pollution," the codes "air pollution," "noise pollution," "water pollution," and "soil pollution" are seen as the most prominent codes, respectively. It is noteworthy that the codes under this category in the mind maps are depicted with details in a way to express the concepts exactly. For example, while expressing the noise pollution code, a figure of a man shouting with a megaphone in his hand and, while expressing air pollution, the gases emitted from factories, the gases from car exhausts rising into the air, and forest fires were depicted. Again, soil pollution was depicted in the form of small grains of chemical fertilizer and solid wastes on the soil. When the "natural causes" category is analyzed, the codes "volcanic eruptions" and "volcanoes" stand out. While expressing these codes, volcano and erupting volcano figures were generally drawn. Under the "artificial causes" category, the codes "forest fires," "garbage," "motor vehicles," and "industrialization" were formed. When the artificial causes category was examined, it was noteworthy that human-induced situations that cause global environmental problems and environmental pollution types were depicted in a way to create a plot. For example, the industrialization code is usually depicted with figures of factories and gases emitted from factories. Under the "Consequences" category, the codes "historical artifacts" and "climate change" were formed. It is noteworthy that these codes are among the consequences of acid rain and global warming and are depicted with figures of polar bears, ice ages, and acid rain on historical artifacts. Finally, although there was no particularly emphasized code under the "Precautions" category, the codes "Filter," "Mask," and "Recycling" were formed and illustrated. For example, the recycling code was illustrated with a recycling symbol, and the mask code was illustrated with a medical mask figure.

Examples from the mind maps of pre-service teachers related to these codes and themes are given in Figure 3.

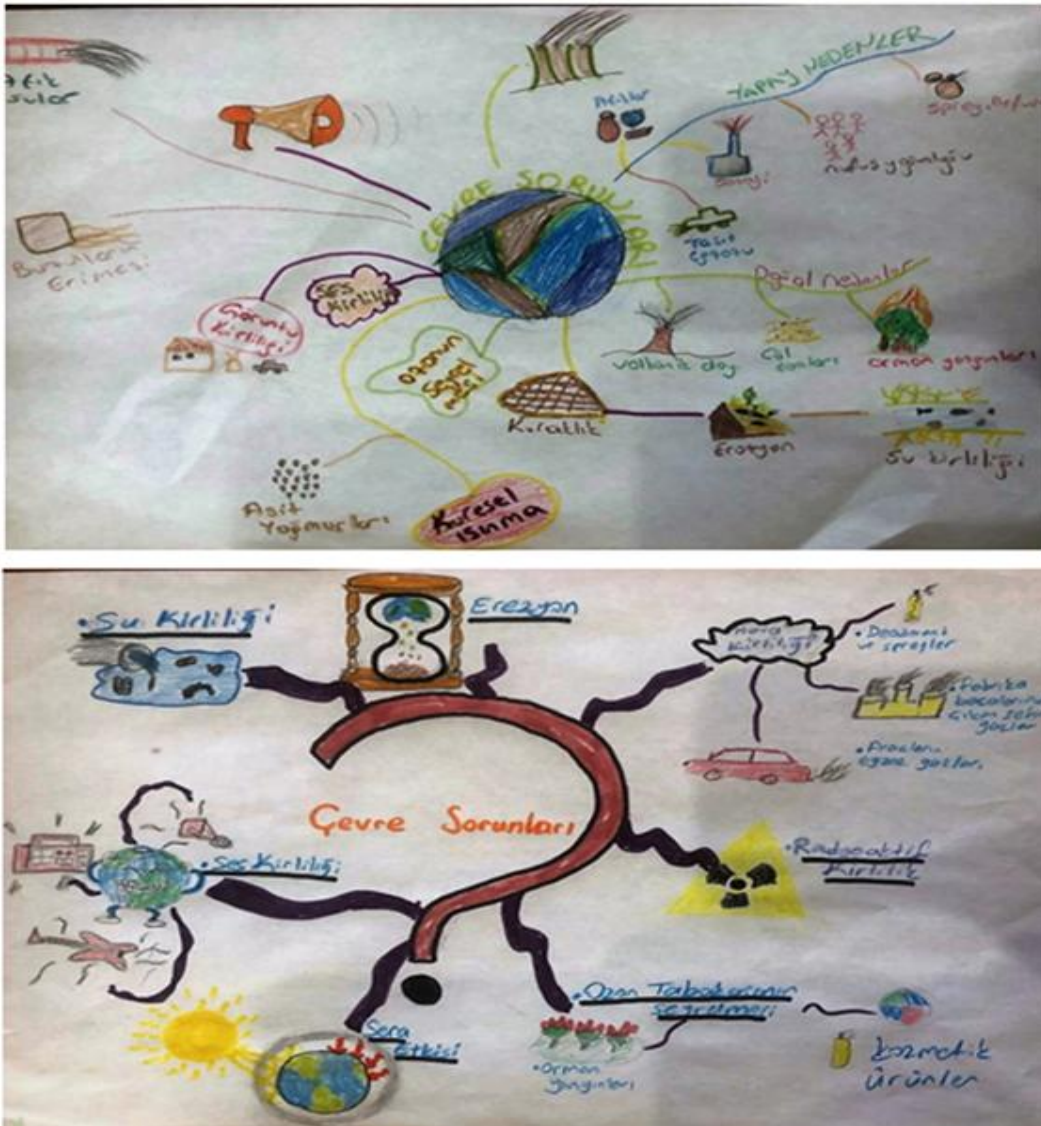**Figure 3. Examples from Mind Maps of the Jigsaw Group**

CONCLUSION AND DISCUSSION

In this study, it was aimed to examine the effects of different methods of the cooperative learning model on pre-service primary school teachers' attitudes towards environmental problems, conceptual knowledge changes and to reveal their cognitive perceptions. In line with the aim of the study, according to the findings obtained from the pretest of the attitude scale, it was concluded that the attitudes of the pre-service teachers in the STAD and Jigsaw groups towards environmental problems were similar and positive before starting the applications. It is thought that the reason for this result is that the prospective teachers enrolled in the department with similar scores and had similar experiences in the same environment. According to the findings obtained from the post-tests, the STAD and Jigsaw methods slightly increased the pre-service teachers' attitudes towards environmental problems. However, this increase was not statistically significant. In other words, cooperative learning methods were not effective in changing pre-service teachers' attitudes towards environmental problems. When the averages of the scores of the pre-service teachers from the scale were analyzed, it was concluded that the averages in the pre-tests were very close to the highest average score value that could be obtained from the scale (agree level), that is, the attitudes of the pre-service teachers were high. Therefore, the fact that the attitudes of the pre-service teachers in the STAD and Jigsaw groups towards environmental problems were quite high in the positive direction before the applications started caused the difference to be statistically insignificant, although there was an increase in the post-tests. In addition, it was determined that the attitudes of the pre-service teachers in the Jigsaw group towards environmental problems were positively and higher than the attitudes of the pre-service teachers in the STAD group. However, when the test scores of both groups were compared, it was concluded

that this difference was not statistically significant. In other words, STAD and Jigsaw methods affected pre-service teachers' attitudes towards environmental problems positively at a similar rate, albeit slightly. When the literature was examined, similar to the results of the study, it was concluded that the attitudes of pre-service teachers did not change significantly in the courses in which environmental problems were taught with activities based on an active learning approach (Muşlu Kaygısız, 2020). Considering that cooperative learning is one of the active learning approaches, it can be said to be in parallel with the research results. Contrary to the research results, Uyanık (2016) found that cooperative learning methods positively increased the attitudes of pre-service teachers towards environmental problems and that cooperative teaching increased motivation and interest in the course. Akkurt (2010) concluded that activities prepared according to active learning methods improved students' attitudes towards environmental pollution compared to traditional methods. As an outcome of their study, Muşlu Kaygısız, Benzer, and Dilek Eren (2019) stated that activities based on active learning did not have a significant effect on pre-service teachers' environmental behaviors and environmental ethics awareness, while they caused a positive change in environmental education self-efficacy.

Concerning the findings on how the cooperative learning methods (STAD and Jigsaw) applied to the pre-service teachers affected the change in their conceptual knowledge, it was determined that while the number of words revealed in the post-tests increased, the number of word types decreased in the STAD and Jigsaw groups. In addition, in both groups, although all the blanks (10 blanks) left for the pre-service teachers to write the concepts in the pre-tests were partially empty, they were filled with directly related and meaningful words related to environmental problems in the post-tests. One of the striking elements here is that in both groups, instead of the concepts such as unconsciousness and lack of education, which were repeated the most in the pre-tests, although they were related to environmental problems, the basic concepts related to global environmental problems (greenhouse effect, ozone depletion, etc.) and environmental pollution types (radioactive pollution, noise pollution, etc.) were repeated more in the post-tests. This result shows that the quality of the concepts increased in the post-tests. In the literature, it is stated that the level of understanding of a concept depends on the other words associated with that concept and the quality of these words. In addition, it has been stated that in order to determine how much a concept is understood, the relationship level and number of response words associated with that concept can be utilized (Boz & Arı, 2020; Bahar et al., 2006). In parallel with this situation, it can be said that the main factor in the decrease in the variety of response words while the number of response words increased in the study is related to the increase in the quality of the response words produced. For example, while a pre-service teacher in the STAD group produced words such as death, fear, uneasiness, and burnout in the pre-test, he produced words such as greenhouse effect, global warming, air pollution, and water pollution in the post-test. In the Jigsaw group, one pre-service teacher produced words such as crowd, hopelessness, and disease in the pre-test, while in the post-test he produced concepts related to global environmental problems and various types of environmental pollution such as drought, global warming, air pollution, and water pollution. This situation is similarly observed among the other pre-service teachers in the groups. According to these findings, it was concluded that cooperative learning methods had positive effects on pre-service teachers' knowledge about environmental problems and provided a positive change in their conceptual knowledge. In the literature, it is stated that the cooperative learning model enables students to achieve a high level of success in subjects related to humans and the environment (Eyüboğlu & Doymuş, 2023), and this is due to the fact that peers are responsible for each other's learning and information sharing in groups during the implementation of cooperative learning methods (Sunggingwati, 2018; Thurston, Cockerill, & Chiang, 2021). It can be stated that critical features such as positive commitment, face-to-face interaction, and individual responsibility, which are inherent in cooperative learning methods, are effective. Similarly, it can be said that change occurs due to the nature of co-operative learning methods. It can be said that the fact that each student knows that he/she will contribute to the group in line with his/her individual success and the mini-exams related to the subjects in the STAD method provide better learning of the concepts. In the Jigsaw method, it can be said that activities such as forming expert groups and then returning to the original groups and continuing learning until the subjects are learnt are effective in the formation of this result. In the literature, it was determined that cooperative learning increased pre-service teachers' academic achievement towards environmental problems and their level of knowledge about environmental problems (Uyanık, 2016). Okumuş (2021) stated that cooperative learning methods increased pre-service teachers' academic achievement in environmental problems. In Gürbüz, Çakmak, and Derman's (2012) study, in the environmental education given to experimental and control groups with similar cognitive levels, it was revealed that the effects of the cooperative learning model applied in the experimental group on the increase of students' cognitive levels were higher than in the control group. In the studies conducted in the literature, it was concluded that active learning methods and techniques have positive effects on increasing the level of knowledge about environmental problems and developing positive attitudes towards the environment (Arık & Yılmaz, 2020).

Based on the findings obtained from the mind maps prepared by the pre-service teachers in both groups after the practices carried out in the STAD and Jigsaw groups, it was concluded that an awareness was formed about global environmental problems, types of environmental pollution, natural and artificial factors causing environmental problems, the consequences of environmental problems, and the measures that can be taken to prevent these problems. The most frequently expressed concepts in mind maps were air pollution, water pollution, and noise pollution, although the order changed in both groups. It is thought that this result is due to the fact that there are environmental problems that pre-service teachers encounter the most in their environment, depending on their daily life experiences. When the categories were analyzed, it was concluded that the titles were global environmental problems, types of environmental pollution, causes, consequences, and precautions. It is

thought that this is due to the fact that the subjects in cooperative learning groups are learned in an organized and systematic way by dividing them into subheadings such as what environmental problems are, how they occur, their consequences, and the measures to be taken against environmental problems. Parallel to the results of the research, in a study conducted by Kiryak, Candas, and Özmen (2021), the cognitive structures of pre-service teachers on environmental problems were examined, and the findings revealed that pre-service teachers tended to explain environmental problems with their observations in daily life rather than scientific facts. Such detailed and systematic results were not found in the studies in which the cognitive perception of environmental problems was revealed without using any teaching method. In the studies, it was determined that themes and codes related to types of environmental pollution and natural and human environmental problems were generally formed (Erduran Avcı et al., 2013; Hamalosmanoğlu, 2020; Öner, 2022; Özata Yücel & Özkan, 2018).

RECOMMENDATIONS

Some suggestions were made in line with the results obtained from the research. According to the results obtained from the research, it was determined that the attitudes of pre-service teachers were high before the applications. For this reason, it is recommended to identify individuals with low attitudes towards environmental problems at the beginning and to carry out studies with these individuals and to investigate the effectiveness of cooperative learning methods. Additionally, qualitative studies can be conducted to deeply explore the effects of cooperative learning methods on attitudes towards environmental problems. Given that cooperative learning methods positively influence the conceptual knowledge change of pre-service teachers towards environmental problems, it is suggested to carry out similar studies using cooperative learning methods at different educational levels. In parallel, it is recommended to conduct mixed-method studies investigating the effects of cooperative learning methods on cognitive perceptions related to environmental problems with students at different educational levels, especially in early childhood education, primary school, and middle school, where environmental awareness begins to develop.

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I hereby declare that the study has not unethical problems and that research and publication ethics have been observed carefully.

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| Research Article / Araştırma Makalesi|

Examining Cyberbullying and Digital Citizenship of High School Students[1]

Lise Öğrencilerinin Siber Zorbalık ve Dijital Vatandaşlıklarının İncelenmesi

Hacer ALAKUŞ[2], İdris GÖKSU[3]

Abstract

Purpose: This research aimed to determine the relationship between cyberbullying and digital citizenship of high school students. It also aims to reveal how cyberbullying and digital citizenship scores differ according to various sociodemographic variables and technology use.

Design/Methodology/Approach: The correlational survey model was used. The data for this study was collected in 2022 from 204 high school students (male = 103, female = 101) aged 13-18 from six schools in XXX city. The Cronbach Alpha reliability coefficient was calculated as .94 for cyberbullying and .79 for digital citizenship. Data were analyzed using correlation analysis, *t*-test, and one-way ANOVA.

Findings: According to the results, it was determined that there was no statistically significant relationship between students' cyberbullying and digital citizenship. Additionally, students' cyberbullying scores do not differ according to gender. However, it was revealed that female students' digital citizenship scores were statistically significantly higher than males. It has been determined that the cyberbullying level of students with higher family income levels is also higher, and digital citizenship does not differ according to income level. In addition, it was found that the digital citizenship scores of high school students who use phones are significantly higher than those who do not. The cyberbullying scores of those who use Facebook are significantly lower than those who do not use Facebook. The digital citizenship scores of students who use Twitter, Facebook, and Instagram are significantly lower than those who do not. Finally, WhatsApp users' digital citizenship scores were significantly higher than those who did not use WhatsApp.

Highlights: There is no statistically significant relationship between digital citizenship and cyberbullying. Additionally, cyberbullying does not differ by gender. However, female students' digital citizenship scores were higher than males. Cyberbullying scores of students with high family income were higher than those with low family income. The cyberbullying score of students who use Facebook is higher than those who do not. Finally, it was determined that the digital citizenship scores of those who use Facebook, Twitter, and Instagram are lower than those who do not.

Öz

Çalışmanın amacı: Bu araştırma lise öğrencilerinin siber zorbalıkları ile dijital vatandaşlıkları arasındaki ilişkiyi tespit etmeyi amaçlamaktadır. Ayrıca siber zorbalık ile dijital vatandaşlık puanlarının çeşitli sosyodemografik değişkenlere ve teknoloji kullanım durumuna göre nasıl farklılaştığını ortaya koymaktadır.

Materyal ve Yöntem: Bu çalışmada ilişkisel tarama modeli kullanılmıştır. Bu çalışmanın verileri, 2022 yılında XXX ilinde altı farklı okuldan 13-18 yaşındaki 204 lise öğrencisinden toplanmıştır. Cronbach Alpha güvenirlik katsayısı siber zorbalık için .94, dijital vatandaşlık için .79 olarak hesaplandı. Veriler, korelasyon analizi, t-testi ve tek yönlü ANOVA kullanılarak analiz edilmiştir.

Bulgular: Bulgulardan elde edilen sonuçlara göre öğrencilerin siber zorbalıkları ile dijital vatandaşlıkları arasında istatistiki olarak anlamlı bir ilişki olmadığı tespit edilmiştir. Ayrıca öğrencilerin siber zorbalık puanları cinsiyete göre farklılaşmamaktadır. Ancak kadın öğrencilerin dijital vatandaşlık puanlarının erkek öğrencilerden istatistiki olarak anlamlı düzeyde daha yüksek olduğu ortaya çıkmıştır. Aile gelir düzeyi daha yüksek olan öğrencilerin siber zorbalık düzeyinin de daha yüksek olduğu, dijital vatandaşlığın ise gelir düzeyine göre farklılaşmadığı tespit edilmiştir. Ayrıca telefon kullanan lise öğrencilerinin dijital vatandaşlık puanları kullanmayanlara göre anlamlı düzeyde daha yüksek olduğu bulunmuştur. Facebook kullananların siber zorbalık puanları, kullanmayanlara göre anlamlı düzeyde daha düşük çıkmıştır. Twitter, Facebook ve Instagram kullanan öğrencilerin ise kullanmayanlara göre dijital vatandaşlık puanları anlamlı düzeyde düşük çıkmıştır. Son olarak WhatsApp kullananların dijital vatandaşlık puanları kullanmayanlara göre anlamlı düzeyde daha yüksek bulunmuştur.

Önemli Vurgular: Dijital vatandaşlık ile siber zorbalık arasında istatistiki olarak anlamlı bir ilişki yoktur. Ayrıca siber zorbalık cinsiyete göre farklılaşmamaktadır. Ancak, kadın öğrencilerin dijital vatandaşlık puanları erkek öğrencilerden daha yüksek çıkmıştır. Aile geliri yüksek olan öğrencilerin siber zorbalık puanları, aile geliri düşük olanlardan daha yüksek çıkmıştır. Facebook kullanan öğrencilerin siber zorbalık puanları ise kullanmayanlardan daha yüksek çıkmıştır. Son olarak Facebook, Twitter ve Instagram kullananların dijital vatandaşlık puanlarının kullanmayanlardan daha düşük olduğu tespit edilmiştir.

INTRODUCTION

As a result of the need for internet and information technologies, the fact that these technologies make life easier and are attractive to individuals, the time spent in the virtual environment is constantly increasing. According to Turkish Statistical Institute (TURKSTAT, 2021) data, the rate of households with access to the internet has reached 92%, and the rate of individuals using the internet has reached 82.6%. This increase is likely due to many reasons, such as the opportunities offered by technology, its use as an entertainment tool, its convenience in daily life, and the restrictions during the pandemic. According to research, there has been an increase in problematic internet usage rates with the pandemic (Baltacı et al., 2021). Adolescents spend 3-5 hours on the internet daily, and having an internet connection at home (86.3%) and on their mobile phones (88.6%) allows them to have easier access to the internet and information technologies (Sezer Efe et al., 2021). In the USA, it has been observed that there has been a significant increase in individuals' internet usage rates during the pandemic (Statista, 2021).

The increase in internet use may cause individuals who use the internet not to spend enough quality time with their social circle and to experience negative experiences such as cyberbullying (Korkmaz, 2016). Considering the developmental periods, it is seen that the most vulnerable age ranges against risks are late childhood and adolescence (Bayraktar, 2017) and that among adolescents who experience sudden emotional changes in their social environment during this period, aggression increases. Also, they become ruthless during these periods (Li, 2005). In recent research, internet use of more than three hours per day was associated with psychosocial symptoms (Li et al., 2023). Considering this evidence, understanding cyberbullying behavior is of great importance. In this context, this research focuses on the cyberbullying variable, how this variable is related to digital citizenship, and how these variables differ according to various sociodemographic variables and technology use.

Cyberbullying

Bullying is the intentional exposure of an individual to negative statements or actions by people who are stronger or more numerous (Olweus, 1993). Bullying includes actions such as verbal attacks, physical attacks, intimidation, threats, and exclusion. As students moved their social lives to the internet, bullying moved to the cyber environment. According to Smith et al. (2008), cyberbullying is usually defined as an aggressive, intentional act or behavior carried out repeatedly and over time by a group or an individual against a victim who cannot easily defend him or herself. Threats, insulting messages, social media posts, accusations, humiliating actions, or trying to take over someone's account are considered cyberbullying. It can be said that the opportunity to hide one's identity is a trigger for people who commit cyberbullying, and past experiences are also effective in cyberbullying (Arıcak, 2009; Erbiçer, 2017). Individuals' enjoyment of behaving aggressively, wanting to perform behaviors that they cannot express in real life in the virtual environment, and wanting to take revenge on people who mistreat them on the internet are some of the reasons for cyberbullying when the risk of being caught is less (Kowalski et al., 2012).

It is suggested that the increase in cyberbullying, problematic internet use, and risky internet behaviors are related to the duration of internet use (Ünver & Koç, 2017). Erbiçer (2017) concluded that males cyberbullied more than female students. Li et al. (2023)'s research conducted in China revealed that 37.5% of students aged 11-16 admitted that they were involved in cyberbullying. There are also studies indicating that cyberbullying varies depending on the type of school. It has been revealed that students studying in Anatolian high schools (high schools that implement both social and science curricula in Türkiye) engage in more cyberbullying behaviors and are exposed to more cyberbullying behaviors than students studying in Imam-Hatip or Vocational high schools (Özer & Şad, 2021). In another study, it was stated that cyberbullying increased due to the ability to hide one's identity in games and the deficiencies in server hosting services (Tang & Fox, 2016).

While some of those exposed to cyberbullying have the psychological resilience to reduce their anger, some of them may form negative thoughts and feel lonely (Ortega et al., 2009). It is also suggested that exposure to cyberbullying causes high fear and sadness in participants (Caravita et al., 2016). It can also be said that it causes serious problems such as anger, academic failure, loneliness, low self-esteem, and suicide (Beran & Li, 2005). Cyber victims may feel lonely because messages and photos can be easily captured, modified, and shared with people through various software (Storm & Storm, 2006). Cyberbullies can hide their identities, obtain information about the victim, and use that information to humiliate the cyber victim (Tokunaga, 2010). It is stated that the ability of the cyberbully to hide their identity increases the fear experienced by the cyber victim, and in case the bullying turns into sexual exploitation, it can prevent the cyber victim from sharing their experiences with others (Eroğlu, 2011). In a recent study, it has been suggested that bully-victims are the most vulnerable to psychosocial and psychosomatic symptoms (Li et al., 2023).

Studies on this subject show that cyberbullying and cyber victimization are universal problems and are not to be underestimated. Considering that the use of technology and the internet by high school students is increasing daily and the average age of technology and internet misuse is decreasing, it is clear that the issue of adolescents being cyber bullies or victims has become an essential factor. In order to avoid many adverse physical, cognitive, psychological, and social effects, the conscious use of technology, which has a facilitating role in many areas of life, and skills such as digital literacy and digital citizenship have become especially important for children and adolescents. In this context, determining the relationship between and digital citizenship is the focus of this study.

Digital Citizenship

The concept of digital citizenship, which is included in the literature on the correct and conscious use of online technologies by primary and high school students (Çubukçu & Bayzan, 2013), is defined as the responsible behavioral norms of individuals regarding the use of technology (Mossberger et al., 2007). Martin et al. (2020) define digital citizenship as using knowledge and skills to exhibit appropriate behavior in the online environment using digital technology. All individuals using the internet should be aware of the consequences of cyberbullying attempts made against them and should have digital citizenship skills (Horzum & Ayas, 2014). Ribble (2011) states that due to the decreasing age of using digital tools and the innovations and transformations brought by the age, the perception of digital citizenship should start from childhood. They discussed digital citizenship in nine dimensions: digital access, digital communication, digital commerce, digital etiquette, digital law, digital security, digital literacy, digital health and wellness, and digital rights and responsibilities (See Figure 1). In a recent systematic review, Shi et al. (2023) revealed four main factors (demographic, internet use, psychological, and social) affecting digital citizenship.

Figure 1. Digital citizenship dimensions

ISTE (The International Society for Technology in Education), an essential standard regarding digital citizenship, is an association in the USA that deals with using technology in education in the context of information security. In order to implement this unity in education and training, NETS (The National Educational Technology Standards) has created some norms. Many international companies produce applicable content regarding rules and guideline standards, ethical norms when accessing the internet, copyright law, and ensuring online privacy so that internet users can use the internet consciously and safely.

In recent years, the time spent in digital environments and the increase in the use of mobile devices have led individuals to share their private information. Therefore, developing digital citizenship skills will reduce cyberbullying. Existing research in the literature on this subject needs to be expanded. In this context, this study aims to determine high school students' cyberbullying and digital citizenship scores and the relationship between these variables. It also aims to examine whether high school students' cyberbullying and digital citizenship scores differ according to various sociodemographic variables and technology use. Technology use was discussed as the type of device used and preferred social media tools. When deciding on the social media tools to focus on, we chose the tools that we believed were frequently preferred for the relevant age group in Türkiye, based on the reports of Kemp (2023) and TURKSTAT (2023). The research questions are organized as follows:

1. Is there a statistically significant relationship between cyberbullying and digital citizenship of high school students?
2. Do high school students' cyberbullying and digital citizenship scores differ statistically significantly according to sociodemographic variables (age, gender, school type, family income)?
3. Is there a statistically significant difference according to the technology use of high school students (type of technological device they use [tablet, computer, phone], social media tools they use [Facebook, Instagram, Snapchat, Twitter, WhatsApp, YouTube])?

METHOD

Research Design

The correlational survey model, one of the quantitative research methods, was used in this research. The correlational survey model aims to determine how much change between two or more variables (Fraenkel et al., 2012). In the correlational survey

model, whether two or more variables differ together; If there is a difference, its degree is determined, and the relationships between the variables are determined and examined (Büyüköztürk et al., 2012; Karasar, 2011).

Participants

The data of the research were collected in the last months of 2022 from 204 high school students between the ages of 13-18 from six schools in XXX city. Maximum diversity was achieved by collecting data from different types of high schools and different grade levels. The demographic characteristics of the students participating in the research are presented in Table 1.

Table 1. Distribution of Participants According to Demographic Characteristics

Variables	Category	f	%
Gender	Female	101	49.5
	Male	103	50.5
Age	13	3	1.5
	14	43	21.1
	15	44	21.6
	16	70	34.3
	17	36	17.6
	18	8	3.9
School Type	Vocational	43	21.1
	Anatolian*	59	28.9
	Imam Hatip**	70	34.3
	Multi-Program***	27	13.2
	Other (Science, Social Sciences)	5	2.5
Family Income[a]	5.000 TL and below	40	19.6
	5.001 TL –10.000 TL	60	29.4
	10.001 TL-15.000TL	52	25.5
	15.001TL-20.000TL	26	12.7
	20.001 TL and above	26	12.7

Note. We considered the minimum wage in 2022 as the lowest group. We determined the other group range accordingly. * High school that implements a curriculum focused on Science and Social, ** High school that implements a religious education program in addition to science and/or social education program, *** High school that implements both Anatolian high school and vocational high school programs.

Data Collection Tools

The data of this study were collected using the Demographic Information Form (sociodemographic: age, gender, school type, family income level; technology use: type of technological device [tablet, computer, phone] used, social media tools [Facebook, Twitter, Snapchat, YouTube, Instagram, WhatsApp] used), Scale and Digital Citizenship Scale. The Cyberbullying Scale was developed by Garaigordobil (2015), and Eraslan Çapan et al. (2019) adapted to Turkish culture. The scale consists of 42 items and three sub-dimensions: cyberbullying, cyber victimization, and witnessing. The adaptation studies calculated internal consistency coefficient of the total score, bullying, victimization, and witnessing subscales as 0.94. In this study, according to the scale's total score, it was 0.94; according to the cyberbullying, cyber witnessing, and cyber victimization subscales, it was calculated as 0.78, 0.97, and 0.79, respectively. The Digital Citizenship Scale consists of 49 items and eight factors (digital communication, digital rights and responsibility, critical thinking, digital participation, digital security, digital skills, ethics, and digital commerce) developed by Kuş et al. (2017). The original study stated that the internal consistency coefficient of the scale was 0.73-0.83. This study calculated the Cronbach Alpha reliability coefficient as 0.79 according to the digital citizenship total score.

Data Analysis

We analyzed the data with correlation analysis and comparison tests to find answers to the research questions. Skewness and Kurtosis values were calculated for the normality test to determine whether the cyberbullying and digital citizenship scores were normally distributed. The Skewness and Kurtosis coefficients range between -1.5 and 1.5 and can be used as acceptable limit values for normal distribution (Tabachnick & Fidell, 2013). In this context, Pearson Correlation analysis was preferred since Skewness and Kurtosis values were in the relevant range (cyberbullying [Skewness = 1.39; Kurtosis = 1.27], digital citizenship [Skewness = .11; Kurtosis = -.56]), and the data were normally distributed. Additionally, *t*-test and one-way ANOVA analyses revealed how cyberbullying and digital citizenship differ according to technology use and various sociodemographic variables. The data showed normal distribution according to the relevant subgroups. Finally, post-hoc tests such as Tukey and Dunnett's T3 were used to determine which group caused the significant difference in income level. Additionally, Bonferroni correction was made to prevent Type-1 error in multiple group comparisons. If the number of groups compared was five, we took the *p* value as 0.05/10 (e.g., 1↔2, 1↔3, 1↔4, 1↔5, 2↔3, 2↔4, 2↔5, 3↔4, 3↔5, 4↔5) = 0.003, and if the number of groups was six, we took it as 0.05/15.

FINDINGS

Relationship Between Cyberbullying and Digital Citizenship

Correlation analysis was performed to determine whether there is a relationship between cyberbullying and digital citizenship. The results are given in Table 2.

Table 2. Findings on the Correlation Between Cyberbullying and Digital Citizenship

Variables	n	$\bar{X}$	SD	1	2
1. Digital Citizenship	204	3.41	.37	1	-.126
2. Cyberbullying	204	1.25	.32	-.126	1

When Table 2 is examined, it is seen that there is non-significant relationship between the students' cyberbullying ($\bar{X}$ = 1.25, SD = .32) and digital citizenship ($\bar{X}$ = 3.41, SD = .37). This finding shows that as high school students' digital citizenship skills increase, their cyberbullying scores decrease and vice versa; However, it indicates that this increase and decrease did not occur at a significant level.

Cyberbullying and Digital Citizenship According to Various Sociodemographic Variables

We conducted *t*-test and one-way ANOVA analyses to test whether high school students' cyberbullying and digital citizenship scores differ according to age, gender, school type, and family income level. The findings obtained are presented under subheadings.

Cyberbullying and Digital Citizenship of Students by Age

A one-way ANOVA test was conducted to examine the cyberbullying and digital citizenship of the students according to their age. The findings obtained are presented in Table 3.

Table 3. Comparison of Students' Cyberbullying and Digital Citizenship by Age

Age	n	$\bar{X}$	SD		Sum of Squares	Mean Square	F	*p*
Cyberbullying								
13	3	1.07	.08	Between groups	.192	.038	.368	.870
14	43	1.22	.34	Within groups	20.646	.104		
15	44	1.26	.28	Total	20.838			
16	70	1.26	.31					
17	36	1.28	.36					
18	8	1.20	.22					
Digital Citizenship								
13	3	3.39	.36	Between groups	1.670	.334	2.527	.030*
14	43	3.31	.31	Within groups	26.178	.132		
15	44	3.41	.36	Total	27.849			
16	70	3.38	.41					
17	36	3.57	.32					
18	8	3.60	.34					

Note. Bonferroni correction was made for post hoc analyses, **p* <.003.

Table 3 shows that the students' cyberbullying (*p* = .87) and digital citizenship scores (*p* = .03) do not differ statistically according to age.

Cyberbullying and Digital Citizenship of Students by Gender

The findings obtained from the independent samples *t*-test conducted to determine whether there is a significant difference in the students' cyberbullying and digital citizenship scores according to their gender are given in Table 4.

Table 4. Comparison of Students' Cyberbullying and Digital Citizenship by Gender

Variables	Gender	n	$\bar{X}$	SD	t	df	*p*
Cyberbullying	Female	101	1.25	.29	-.231	202	.818
	Male	103	1.26	.34			
Digital Citizenship	Female	101	3.52	.37	4.114	202	.000*
	Male	103	3.31	.34			

* *p* < .01

According to Table 4, the average score for cyberbullying is 1.26 for male students and 1.25 for female students; the average score for digital citizenship is 3.31 for male students and 3.52 for female students. This difference between the scores is not statistically significant in terms of cyberbullying ($t_{(202)}$ = -.231; p > 0.05). A significant difference was detected in terms of digital citizenship ($t_{(202)}$ = 4.114; p < 0.05). These findings show that the cyberbullying scores of high school students do not differ statistically according to gender, and the cyberbullying scores of male and female students are close to each other. It is also understood that the digital citizenship scores of female students are statistically significantly higher than male students.

Cyberbullying and Digital Citizenship of Students by School Type

One-way ANOVA test was applied to determine whether students' cyberbullying and digital citizenship scores differ according to school type. The findings obtained are presented in Table 5.

Table 5. Comparison of Students' Cyberbullying and Digital Citizenship by School Type

School Type	n	$\bar{X}$	SD		Sum of Squares	Mean Square	F	p
Cyberbullying								
Vocational	43	1.25	.33	Between groups	1.021	.255	2.564	.040*
Anatolian	59	1.27	.30	Within groups	19.816	.100		
Multi-Program	27	1.41	.35	Total	20.838			
Imam Hatip	70	1.19	.29					
Other (Science, Social Sciences)	5	1.16	.15					
Digital Citizenship								
Vocational	43	3.38	.31	Between groups	1.221	.305	2.280	.062
Anatolian	59	3.44	.37	Within groups	26.628	.134		
Multi-Program	27	3.45	.39	Total	27.849			
Imam Hatip	70	3.26	.33					
Other (Science, Social Sciences)	5	3.70	.36					

Note. Bonferroni correction was made for post hoc analyses, *p < .005.

According to Table 5, it can be seen that students' cyberbullying (p = .04) and digital citizenship scores (p = .062) do not differ statistically according to school type.

Cyberbullying and Digital Citizenship of Students by Family Income Levels

One-way ANOVA test was applied to examine students' cyberbullying and digital citizenship scores according to their family income. The findings obtained are presented in Table 6.

Table 6. Comparison of Students' Cyberbullying and Digital Citizenship by Family Income Levels

Income Level**	n	$\bar{X}$	SD		Sum of Squares	Mean Square	F	p
Cyberbullying								
5.000 TL and below	40	1.17	.23	Between groups	3.398	.850	9.694	.000*
5.001 TL –10.000 TL	60	1.17	.22	Within groups	17.440	.088		
10.001 TL-15.000 TL	52	1.19	.27	Total	20.838			
15.001TL-20.000 TL	26	1.42	.45					
20.001 TL and above	26	1.52	.36					
Digital Citizenship								
5.000 TL and below	40	3.49	.33	Between groups	1.990	.498	3.829	.005*
5.001 TL –10.000 TL	60	3.52	.36	Within groups	25.859	.130		
10.001 TL-15.000 TL	52	3.31	.33	Total	27.849			
15.001TL-20.000 TL	26	3.41	.39					
20.001 TL and above	26	3.29	.42					

Note. Bonferroni correction was made for post hoc analyses, *p <.005, **We considered the minimum wage in 2022 as the lowest group. We determined the other group range accordingly.

Regarding cyberbullying scores, since the variances of the groups were not homogeneous according to the Levene test result (p = .000), the Dunnett's T3 test was applied and the findings are presented in Table 6. Accordingly, the cyberbullying scores of students whose family income is 5.000 TL and below, 5.001-10.000 TL, and 10.001-15.000 TL, differ significantly from those of students whose family income is 20.001 TL and above. This finding shows that students with higher family income levels have higher scores of cyberbullying.

In the analyses regarding digital citizenship, since the variances of the groups were homogeneous according to the Levene test (p = .490), the Tukey test was applied and the findings presented in Table 6. The results showed that there is no significant difference between the digital citizenship scores of students' according to family income level (p = .005).

Cyberbullying and Digital Citizenship According to Technology Use

In this study, students' use of technology is discussed according to their preference for technological devices and whether they use social media tools. Subgroups in terms of device type show a normal distribution; Comparison tests were made for the variables of phone, tablet, computer, and social media tools such as Facebook, Twitter, Instagram, SnapChat, WhatsApp, and YouTube, and the findings are presented below.

Cyberbullying and Digital Citizenship of Students According to the Type of Technological Devices They Used

The findings obtained as a result of the independent samples t-test conducted according to the usage status of technological devices (used/not used) are presented in Table 7.

Table 7. Comparison of Students' Cyberbullying and Digital Citizenship by Device Type

Device Type	Usage (Yes/No)	Cyberbullying						Digital Citizenship					
		n	$\bar{X}$	SD	df	t	p	n	$\bar{X}$	SD	df	t	p
Smartphone	Y	177	1.27	.32	202	1.821	.070	177	3.45	.35	202	3.397	.001**
	N	27	1.15	.27				27	3.19	.37			
Tablet	Y	34	1.35	.42	39.62	1.53	.132	34	3.32	.42	202	-1.59	.113
	N	170	1.23	.29				170	3.43	.35			
Computer	Y	57	1.34	.38	81.75	2.31	.023*	57	3.44	.33	202	.623	.534
	N	147	1.22	.28				147	3.40	.38			

* $p < .01$

According to Table 7, while students' cyberbullying scores do not differ depending on whether they use a phone or not, their digital citizenship scores differ in favor of those who use a phone. In addition, students' cyberbullying and digital citizenship scores do not differ depending on whether they use a tablet or not. Finally, cyberbullying scores of computer users are higher than those who do not use computers, while their digital citizenship scores do not differ. These findings show that the digital citizenship scores of high school students who use phones are significantly higher. It is also understood that the cyberbullying scores of students who use computers are significantly higher than those who do not use.

Cyberbullying and Digital Citizenship of Students According to the Social Media Tools They Used

The findings obtained as a result of the independent samples t-test conducted to reveal whether there are differences in the cyberbullying and digital citizenship scores according to the social media tools preferred by high school students are presented in Table 8.

Table 8. Comparison of Students' Cyberbullying and Digital Citizenship Scores by Social Media Tools

Usage (Yes/No)		Cyberbullying						Digital Citizenship					
		n	$\bar{X}$	SD	df	t	p	n	$\bar{X}$	SD	df	t	p
Instagram	Y	152	1.28	.33	202	1.89	.060	152	3.38	.35	202	-2.35	.020*
	N	52	1.18	.27				52	3.52	.40			
Youtube	Y	108	1.27	.32	202	.70	.484	108	3.46	.33	202	1.73	.085
	N	96	1.23	.31				96	3.37	.40			
Twitter	Y	101	1.27	.32	202	.89	.373	101	3.30	.33	202	-4.69	.000**
	N	103	1.23	.31				103	3.53	.37			
Facebook	Y	38	1.37	.42	45.17	2.08	.043*	38	3.26	.31	63.90	-3.21	.002**
	N	166	2.22	.28				166	3.45	.37			
Snapchat	Y	27	1.26	.27	202	.21	.829	27	3.39	.31	202	-.36	.717
	N	177	1.25	.32				177	3.42	.37			
WhatsApp	Y	132	1.24	.32	202	-.86	.390	132	3.49	.35	202	4.44	.000**
	N	72	1.28	.30				72	3.26	.34			

* $p < 0.05$, ** $p < 0.01$

According to Table 8, there is no statistically significant difference in the cyberbullying scores of high school students who use Instagram, YouTube, Twitter, Snapchat, or WhatsApp compared to students who do not. However, the cyberbullying scores of high school students who use Facebook are significantly lower than those who do not use. When the findings regarding digital citizenship were examined, it was seen that there was no significant difference in the digital citizenship scores of students who used Snapchat and YouTube compared to those who did not use it. The digital citizenship scores of students who use Twitter,

Facebook, and Instagram are significantly lower than those who do not use. The digital citizenship scores of students who use WhatsApp are significantly higher than those who do not use WhatsApp.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This research aimed to determine the relationship between high school students' digital citizenship and cyberbullying. In this study, the correlational survey model was used. In addition, cyberbullying and digital citizenship scores of high school students were examined according to various sociodemographic variables and technology usage status. The results were obtained as a result of correlational analysis and comparison tests. The findings obtained as a result of the correlation analysis showed that there was no relationship between high school students' digital citizenship and cyberbullying. In their research with secondary school students, Öztürk (2019) concluded that there was a low positive relationship between digital citizenship and cyberbullying. In their research with university students, Kaptangil and Çalışır (2023) found a statistically significant positive relationship between digital citizenship behavior and cyberbullying attitude. They found a negative relationship between the digital security and ethics sub-dimensions of digital citizenship. Zhong et al. (2021) found a negative relationship between university students' digital citizenship and cyberbullying but found that there was no relationship with cyber exposure. Similar studies conducted with young people found a negative relationship between digital citizenship, cyberbullying, and cyber victimization (Hussain & Shah, 2021; Verma & Garg, 2023). According to the results of another study conducted with adults, it was observed that there was a significant negative relationship between cyberbullying and digital citizenship (Karakuş & Turan, 2022). Sakallı (2015) concluded that there was a positive, moderate, and statistically significant relationship between cyberbullying tendencies and digital citizenship scores of classroom teacher candidates. Considering the results we obtained in the study and the existing evidence in the literature, it is noticeable that there are different results (negative, positive, or no correlation) regarding the relationship between digital citizenship and cyberbullying. These different results in the literature show that new research is still needed. Meta-analysis can be conducted to combine all these different results in the literature and reveal more apparent evidence regarding the relationship. Additionally, experimental research can be conducted based on various digital citizenship education programs as the independent variable and cyberbullying as the independent variable.

Another finding obtained in this study is that the cyberbullying scores of high school students do not differ according to gender and age. Many similar studies are showing that the gender variable does not have a significant effect on cyberbullying. Kozan and Bulut-Özek (2019) concluded that there is no difference in digital citizenship and cyberbullying sensitivities according to the gender variable. Similarly, Balakrishnan (2015) revealed that cyberbullying behaviors do not differ according to gender and age. Contrary to these studies, Wright and Wachs (2023) found that male students are more likely to cyberbully and are exposed to cyberbullying than female students in primary school but that females witness cyberbullying more often than males in university. On the other hand, Mohamad's (2023) study with young people found that cyberbullying differed according to gender in favor of males. In the research conducted by Karakuş and Turan (2022), cyberbullying behavior showed significant differences according to age and gender. According to relevant research, males have higher scores of cyberbullying than females, and cyberbullying decreases as age increases. Therefore, although there is strong evidence that males bully more than females, this may vary depending on age and cultural differences, and therefore, generalizations should be avoided.

Another finding we obtained in our study is that cyberbullying and digital citizenship do not differ according to high school type. Similarly, Öztürk (2019) revealed that there was no significant difference in students' cyberbullying tendencies according to school type and monthly income variables. Since socioeconomic level is a factor that may affect access to technological devices and the internet, it is important to examine its relationship with cyberbullying. When the findings regarding family income were examined, it was revealed that the cyberbullying of students with higher family income levels was higher, and the digital citizenship scores of the group with the highest family income level were significantly lower than the students with relatively lower family income levels. The high rate of cyberbullying among students with high family incomes may be related to the individuals' access easier to the internet and technological devices, which may have reduced the level of digital citizenship. Balakrishnan (2015) found that internet frequency significantly predicts cyberbullying. However, we need more convincing scientific information on this subject. Therefore, in-depth qualitative research to be conducted with high school students with high family income and their parents can reveal why digital citizenship is low, and cyberbullying is high in the relevant individuals. Identifying the causes can contribute to the prevention of cyberbullying.

The study also examined the digital citizenship levels of high school students in terms of various variables such as gender, age, school type, and family income. It was observed that there was a significant difference in favor of females according to gender, but there was no difference according to school type. A systematic review revealed that individuals' age and gender factors predict digital citizenship (Shi et al., 2023). In another systematic review, Ali et al. (2023) revealed that a significant portion of the relationships identified regarding sociodemographic variables affecting digital citizenship were insignificant. Hollandsworth et al. (2017) emphasize that educators and administrators should develop digital citizenship awareness at an earlier age. According to some studies, gender does not affect digital citizenship behavior (Er Türküresin, 2022; Akcil & Bastas, 2021; Kabataş, 2019). Some studies reach similar results to this study and show that the effect of gender on digital citizenship is in favor of females (Korucu & Totan, 2020; Tanoğlu, 2019). Therefore, although we concluded in our study that digital citizenship does not differ by gender, there is also evidence to the contrary. Also, the conclusions of systematic reviews are not consistent in this context. As a result, we can say that stronger evidence is needed to claim that digital citizenship differs by gender.

In this study, it was determined that whether high school students use smartphones in daily life does not create a significant difference in their cyberbullying scores. However, it creates a significant difference in their digital citizenship scores. In addition, it was observed that whether they used a tablet or not did not make a significant difference in cyberbullying and digital citizenship. It was observed that computer users had a significantly higher rate of cyberbullying than those who did not use computers. However, there was no significant difference in terms of digital citizenship. According to the findings regarding social media tools, which are one of the critical factors determining technology usage, the cyberbullying scores and digital citizenship scores of high school students who use Facebook are significantly lower than those who do not use Facebook. The digital citizenship scores of students who use Twitter and Instagram are significantly lower than those who do not. The digital citizenship scores of students who use WhatsApp are significantly higher than those who do not use WhatsApp. As the rate of using social media increases, cyberbullying and cyber victimization may also increase. Kırlı (2020) revealed that social media has a high impact on high school students regarding cyberbullying, and exposure to cyberbullying isolates students and negatively affects their emotional and social communication.

Longitudinal studies can be conducted to examine the interests and tendencies of students who are intertwined with the digital world and use technology intensively. For example, cyberbullying, digital citizenship levels, and technology usage habits can be measured at the beginning of each academic year for four years in universities, high schools, or secondary schools. In this context, in new studies, the effects of cyberbullying and the reflection of digital citizenship skills on individuals' behavior can be addressed from different perspectives. For this and similar studies, it is important to re-examine the variables in question with larger samples to obtain more convincing results. While some studies show that students are connected to the digital world and are at risk, it is clear that there is a need to increase the participation of schools in raising globally responsible digital citizens. It is also clear that schools should integrate digital citizenship into their educational programs (Capuno et al., 2022). Research shows that approximately half of the students' internet/social media usage is monitored by their parents, and approximately two-thirds of the students are not taught digital citizenship in their schools (Martin et al., 2020). Therefore, providing students with in-depth information on internet usage is essential in the context of opportunities and risks. It should be taken into consideration that cyberbullying and digital citizenship are critical issues for students at all grade levels, and all relevant organizations must include more conferences, seminars, and similar events in their activities.

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The Relationship Between Metacognition and AcademicAchievement in Adolescents: The Mediating Role of Academic Self-Control

Ergenlerde Üstbiliş ve Akademik Başarı Arasındaki İlişki: Akademik Öz Kontrolün Aracı Rolü

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Abstract

Purpose: The purpose of this study was to investigate the correlations between metacognition, academic self-control (ASC), and academic achievement among adolescents who attend secondary and high school and to test the mediating role of ASC in the correlation between metacognition and academic achievement.

Design/Methodology/Approach: The investigation was carried out using a correlational research approach. The sample group consisted of 572 adolescents (M = 14, SD = 1.28), who were aged between 11 and 17 years and studying in secondary and high schools in two cities in Türkiye. Demographic Questionnaire, Academic Self-Control Scale, and Metacognitive Awareness Inventory for Children were used in the study. The Jamovi V 2.2 software was utilized to analyze the data.

Findings: The Pearson correlation analysis showed that metacognition was positively associated with ASC and grade point average (GPA). Academic self-control was also positively correlated with GPA, as well. Moreover, the results of the current research demonstrated that the direct and indirect effects of metacognition on academic achievement were significant, and ASC played a partial mediating role in this correlation.

Highlights: The study's findings were discussed within the frame of the related literature, implications for theory were drawn, and suggestions for future studies were offered.

Öz

Çalışmanın amacı: Bu araştırmada ortaokul ve lisede öğrenim gören ergenlerin üstbiliş, akademik öz-kontrol ve akademik başarıları arasındaki ilişkilerin incelenmesi ve üst biliş ile akademik başarı arasındaki ilişkide akademik öz-kontrolün aracı rolünün test edilmesi amaçlanmıştır.

Materyal ve Yöntem: Araştırma ilişkisel tarama modeline göre yürütülmüştür. Araştırma grubunu yaşları 11 ile 17 arasında değişmekte olan Türkiye'nin iki farklı şehrinde ortaokul ve lisede öğrenim gören 572 (M = 14, SD = 1.28) ergen oluşturmaktadır. Araştırmada Demografik Bilgi Formu, Akademik Öz-Kontrol Ölçeği ve Üst Bilişsel Fakındalık Ölçeği kullanılmıştır. Araştırma verilerinin analizinde jamovi V 2.2 paket programı kullanılmıştır.

Bulgular: Verilere uygulanan pearson korelasyon analizi neticesinde, üst bilişin akademik öz-kontrol ve GPA ile pozitif yönde ilişkili olduğu sonucuna ulaşılmıştır. Akademik öz-kontrolün de GPA ile pozitif ilişkili olduğu görülmektedir. Ayrıca araştırma sonucunda üst bilişin akademik başarı üzerindeki doğrudan ve dolaylı etkilerinin anlamlı olduğu ve akademik öz-kontrolün bu ilişkide kısmi aracı rolü olduğu görülmüştür.

Önemli Vurgular: Araştırmanın bulguları ilgili literatür çerçevesinde tartışılmış, kuramsal çıkarımlar elde edilmiş ve ilerde yapılacak araştırmalara yönelik öneriler sunulmuştur.

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INTRODUCTION

Since societies today consider adolescence a preparatory process for professional life in adulthood, academic achievement is an essential issue in this period (Rana & Mahmood, 2010; Steinberg, 2007). According to a theoretically based definition, academic achievement is a concept that consists of factors such as the acquisition of skills and competencies, satisfaction, perseverance, achievement of learning goals, and career success (York, 2015). It is possible to consider academic achievement as an outcome of education and acknowledge it as an indicator of to what extent a student, teacher, or educational institution has achieved its goals. Although academic achievement is usually assessed by exams, no consensus on how to assess it has been reached (Aduke, 2015). However, studies have pointed out that academic achievement has become increasingly functionalized with grades or grade point averages (GPA) (York, 2015). When the literature is reviewed, many studies have been found wherein GPA was used for academic achievement (Bahçetepe & Giorgetti, 2015; Choi, 2005; Qutishat & Sharour, 2019; Ward & Butler, 2019). From this perspective, the academic achievement of the students in this study was assessed by GPA.

Academic achievement is an important issue in school counselling (American School Counselor Association [ASCA], 2023), as it enables students to determine the course of their lives from primary education to higher education, and future expectations (Tokgöz, 2022). As licensed educators, school counsellors provide a school counselling program that assists the academic development of all students to achieve and exceed high academic standards (ASCA, 2023). In this context, they use interventions to improve the academic performance of students. To get the desired results, the interventions are required to be based on empirical evidence (Brown & Trusty, 2005). Therefore, identifying the variables influencing students' academic success experimentally may provide a substantial contribution to program development and intervention studies.

Academic success is one of the determinants of life success and well-being both in adolescence and adulthood (Hogan et al., 2010). The related research in the literature showed that academic achievement is positively correlated with positive indicators of psychological adjustment such as life satisfaction (Gilman & Huebner, 2006; Verkuyten & Thijs, 2002), psychological well-being (Yildiz Durak et al., 2022), subjective well-being (Bücker et al., 2018), and self-esteem (Li et al., 2018). On the other hand, low academic achievement is associated with behavioral dependencies (Sahin et al., 2016; Zhang et al., 2018), substance abuse, violent behavior (Herndon et al., 2015), conduct problems, and mental health problems (McLeod et al., 2012; Myat Zaw et al., 2022). Hence, it is crucial to identify the components that affect academic achievement for the prevention of academic failure and to lead the way for the development of various intervention approaches. Accordingly, this study aimed to demonstrate the correlations between metacognition, ASC, and academic achievement levels of adolescents who attended secondary and high schools.

Metacognition and Academic Achievement

Metacognition is a term that entered psychology in the 1970s and educational and developmental psychologists (Schwarz, 2015) that refers to thinking activities about thinking and cognitions about cognition (Flavell, 1979; Karakelle & Saraç, 2010). A concept employed to describe learning, metacognition covers the mechanisms by which students manage their studies (for instance, by selecting study intervals and what and how to study during this time) and track their progress. (Hennecke & Bürgler, 2022). Metacognition includes the processes of monitoring, controlling, and regulating cognition (Pintrich, 2002). More specifically, it is characterized by metacognitive experiences, emotions (e.g., familiarity, hardship), judgments (e.g., learning judgment), and task-specific online information (Efklides, 2006).

Metacognition literature has pointed out that metacognition consists of two dimensions: knowledge about cognition and regulation of cognition (Flavell, 1979; Kallio et al., 2018). Knowledge of cognition is related to information or ideas about how various elements or variables interact to influence the nature and results of cognitive procedures (Flavell, 1979). Cognitive knowledge is composed of three subcomponents: Conditional knowledge (understanding when and why to learn), declarative knowledge (understanding the elements of learning), and procedural knowledge (understanding how to apply learning techniques) (De Jong & Ferguson-Hessler, 2010; Schraw et al., 2006). Additionally, the regulation of cognition defines a set of actions that support students in controlling their learning process (Vrugt & Oort, 2008). These activities involve skills that facilitate individuals' learning, such as organizing information, understanding monitoring approaches, debugging techniques, and evaluation strategies (Schraw & Dennisson, 1994; Veenman et al., 2006). Consequently, it can be asserted that metacognition plays a critical role in individuals' learning and studying (Tuononen et al., 2023) and affects academic achievement. Hence, numerous studies have reported that metacognition is associated with high levels of academic performance (Ohtani & Hisasaka, 2018; Veas et al., 2019; Ward & Butler 2019). The meta-analysis study conducted by Ohtani and Hisasaka (2018) showed that metacognition was one of the important indicators of academic performance when the variable of intelligence was taken under control.

Metacognition and Academic Self-Control

Self-control is characterized as the ability to overcome temptation and unwanted impulses and willingly regulate emotions, thoughts, attention, and behaviors in order to achieve more worthwhile goals in the long term (Milyavskaya et al., 2019; Tangney et al., 2004; Vohs & Baumeister, 2004). Good levels of self-control are linked to beneficial outcomes in a variety of areas of life, such as academic achievement, positive interpersonal relationships, confident financial behaviors, physical health, and

psychological well-being (de Ridder et al., 2012; Duckworth & Seligman, 2005; Şimşir & Dilmaç, 2022; Tangney et al., 2004). Therefore, some psychologists consider self-control as the "greatest human strength" (Baumeister & Tierney, 2011). However, it is often difficult to display self-controlled behavior. This is because self-control may require forgoing chocolate while on a diet, ignoring a text message on the phone to get to the end of reading an important article, or hitting the gym instead of wasting time watching TV for hours on end (Duckworth et al., 2016). Similarly, almost all students are faced with a dilemma between academic goals that they care about in the long term and non-academic goals that they find more satisfying at the moment (Duckworth et al., 2019). They, therefore, need strong ASC skills to resolve this dilemma in line with their long-term goals.

Self-control people exhibit in the academic domain is conceptualized as ASC (Büyük et al., 2020). ASC includes perseverance, self-study, the ability to delay instant gratification, efficient time management, planning, and approaches to problem-solving that facilitate coping with academic challenges (Kennett & Keefer, 2006). The ASC includes two key components: academic self-compassion, which involves adopting a compassionate and polite attitude towards oneself when confronted with personal setbacks, and academic resourcefulness, which entails possessing the resources to cope with the challenges and barriers encountered in the pursuit of academic objectives (Büyük et al., 2020; Martin & Kennett, 2018). These processes related to ASC require the use of metacognitive skills. Indeed, Duckworth et al., (2014) highlighted that self-control is metacognitive in nature.

The *process model of self-control* proposed by Duckworth et al., (2014; 2016) suggests that school-age children must require the implementation of self-control, a skill that relies on mastering metacognitive, prospective strategies to resolve conflicts in the academic domain. According to the model, there are five sequential strategies for dealing with unwanted impulses (situation selection, situation modification, attentional deployment, cognitive change, and response modulation), and such strategies are based on metacognitive skills. During the process of ASC, individuals endeavor to metacognitively manage their own behaviors, emotions, and thoughts in order to resolve the conflict in accordance with their objectives.

Academic Self-Control and Academic Achievement

The factors influencing academic achievement have been among the prominent research topics for scientists from many disciplines from the past to the present (Dilmaç & Şimşir Gökalp, 2022). Over the past decades, academic achievement has been acknowledged to rely on cognitive elements such as academic skills and intelligence (Khine, 2016). However, recent studies have shown that noncognitive factors such as self-control and perseverance are important determinants of academic achievement (Duckworth & Seligman, 2005; 2006). Noting that females are more successful than males in almost all subjects at all levels of education, the study conducted by Duckworth and Seligman (2006) reported that this difference lies not in the higher intelligence of girls but in their higher self-control. Students with strong self-control handle self-control conflicts in accordance with their long-term objectives. For instance, they prefer to study math, a course that is more valuable in the long run but not as fun at that moment, rather than scrolling through Instagram, an activity that is enjoyable at that moment (Duckworth et al., 2019). Having self-control skills in the academic domain involves behaviors such as reading the instructions of the test before moving on to the questions, concentrating on the teacher instead of daydreaming, doing assignments rather than watching TV, insisting on the task despite boredom and failure, and postponing academic tasks less (Duckworth & Seligman, 2006; Kennett et al., 2013). Briefly, students with high self-control in the academic domain seek ways to solve their personal problems and use effective methods to succeed; they neither give up easily nor get anxious (Büyük et al., 2020).

Advancements in information and communication technologies have accelerated the need for students to adopt self-control skills. Although the academic tasks of students have been quite similar across generations (homework, exams, quiz, etc.), competitive digital distractions (social media, video games, etc.) have dramatically increased in recent years (Duckworth et al., 2019). The amount of time students spend in front of a screen has risen substantially, especially during the COVID-19 pandemic (Şimşir Gökalp et al., 2022). During and after the pandemic, noncognitive abilities including motivation and self-regulation that affect students' academic achievement have become more significant (e.g., Yildiz Durak et al., 2022). Therefore, there is a need for further studies on the processes that underlie ASC and the consequences it brings about.

The Present Study

As aforementioned, academic achievement, one of the factors affecting the future lives of adolescents, is a significant developmental task (Havinghurts, 1972). Therefore, the determination of the dynamics that improve academic achievement can significantly contribute both to the literature and to the intervention programs to be developed. For example, school counselors can integrate activities related to ASC and metacognition into group counseling programs to improve students' academic performance. Likewise, teachers can also include some activities to help students acquire these skills. This study aimed to examine the correlations between metacognition, ASC, and academic achievement among adolescents who attend secondary and high school and to test the mediating role of ASC in the correlation between metacognition and academic achievement. The following hypotheses would be tested for this purpose:

H1. Metacognition significantly and directly predicts academic achievement in adolescents.

H2. Metacognition directly predicts ASC in adolescents.

H3. ASC directly predicts academic achievement in adolescents.

H4. Metacognition predicts academic achievement through ASC in adolescents.

METHOD/MATERIALS

Design

The present investigation adopted a correlational research approach founded on the method of quantitative research. The goal of a correlational study is to investigate the links between two or more variables without manipulating them (Fraenkel et al., 2012). In this study, academic achievement is the dependent variable, metacognition is the independent variable, and ASC serves as the mediating variable.

Participants and Procedures

The data for this study were gathered from adolescents in a high school and a secondary school in two distinct big cities in Türkiye. The study comprised 596 students in total. 24 students were removed from the data set due to incomplete responses, and analyses were then performed on the remaining 572 participants in the data set. 60.1% of the participants were female (344), and 39.9% (228) were male. The ages of the participants ranged from 11 to 17 (M = 14, SD = 1.28).

Data for the study were gathered in the 2022-2023 academic year. Ethical permission was received from the ethics committee of the Faculty of Education at a public institution before collecting research data. Following that, approval was acquired from instructors and school administration where the data would be gathered. During class time, school counselors entered the classrooms to gather data face-to-face from the students. The students were informed about the principles of volunteering and the objective of the study prior to data collection. The students filled out the scales in around 15 to 20 minutes.

Instruments

Demographic Questionnaire: It was developed by researchers to gather details about the participants' gender, age, grade level, and GPA.

Academic Self-Control Scale (ASCS): The ASCS was created by Büyük et al. (2020) to assess secondary school students' ASC behaviors. ASCS comprises 12 items and two sub-dimensions (academic perseverance and academic attention). Each item in the scale is scored between 1 and 5 (1= Never, 5=Always). Higher scores on the measure indicate greater academic control. The following is an instance of a scale item: "Even if my desk-mate tries to make me chat, I pay my attention to the lesson". The scale's overall Cronbach alpha coefficient was .81. The Cronbach alpha coefficient in the present investigation was determined to be .79. According to the confirmatory factor analysis (CFA) results, the goodness of fit indices of the scale is within the acceptable ranges ($\chi2/sd$ = 2.94, CFI = .97, TLI = .91, RMSEA = .06).

Metacognitive Awareness Inventory for Children (Jr. MAI-B Form): Jr. MAI-B was created by Sperling et al. (2002) to assess students' metacognitive abilities in grades three through nine. The Turkish translation study of the scale was conducted by Karakelle and Saraç (2007). The A form of the Jr. MAI is used for students in the 3rd to the 5th-grade range, and the B form is used for 6th to 9th-grade students. The scale has a one-dimensional structure and each item in the scale is scored between 1 and 5 (1= not suitable for me at all, 5= suitable for me all). An example item in the scale is as follows: "I know whether I understand something or not". The scale's overall Cronbach alpha coefficient was .80. The Cronbach alpha coefficient in the present investigation was determined to be .87. According to the CFA results, the goodness of fit indices of the scale is within the acceptable ranges ($\chi2/sd$ = 2.41, CFI = .92, TLI = .96, RMSEA = .05).

Data Analyses

The data analysis for this study was completed in two steps. In the first step, descriptive statistics such as mean, standard deviation (SD), normality distribution (skewness and kurtosis values), and Pearson correlation coefficients were calculated for the preliminary analyses. The correlation coefficient was examined to determine whether there was a multicollinearity problem. According to Tabachnick and Fidell (2015), a correlation coefficient above .90 indicates a multicollinearity problem. Furthermore, the scales' Cronbach alpha coefficients were examined at this step. In the second step, a mediation analysis was performed to identify whether ASC had a mediating role in the association between metacognition and academic achievement 5000 bootstrap samples with a 95% confidence interval (CI) proposed by Hayes (2018) were used to assess the statistical value of the mediating effects of the model examined in the study. This analysis suggests that the interval between these two values should not contain zero and that the lower and upper limits of the CI values should take values in the same direction (Hayes, 2018). The data analysis was performed using the software jamovi V 2.2 (R Core Team, 2021; The Jamovi Project, 2021).

FINDINGS

Preliminary Analyses Results

Table 1 displays the descriptive statistics and Pearson's correlation coefficients for the variables investigated in the study.

Table 1. Descriptive Statistics and Correlations Among Study Variables

Variable	1	2	3	M	SD	Skew.	Kurt.
1. Meta-cognition	-			66.35	11.13	-.30	.07
2. ASC	.51**	-		40.56	9.24	.35	-.51
3. GPA	.36**	.44**		71.67	11.57	.05	-.36

**p < .001, ASC: Academic Self-Control, GPA: Grade Points Average

The preliminary analysis results demonstrated that skewness values ranged between -.30 and .35. The kurtosis values ranged between -.51 and -.36. According to George and Mallery (2022) because all of the values fall within the range of -2 to +2, this suggests that the distribution characteristics are suitable for further analysis. The results of Pearson correlation analysis showed that meta-cognition was positively correlated with ASC ($r = .51$, $p < .001$), and GPA ($r = .36$, $p < .001$). ASC was also positively associated with GPA ($r = .44$, $p < .001$).

Mediation Analysis Results

Mediating model results established using the research variables are displayed in Figure 1 and Table 2.
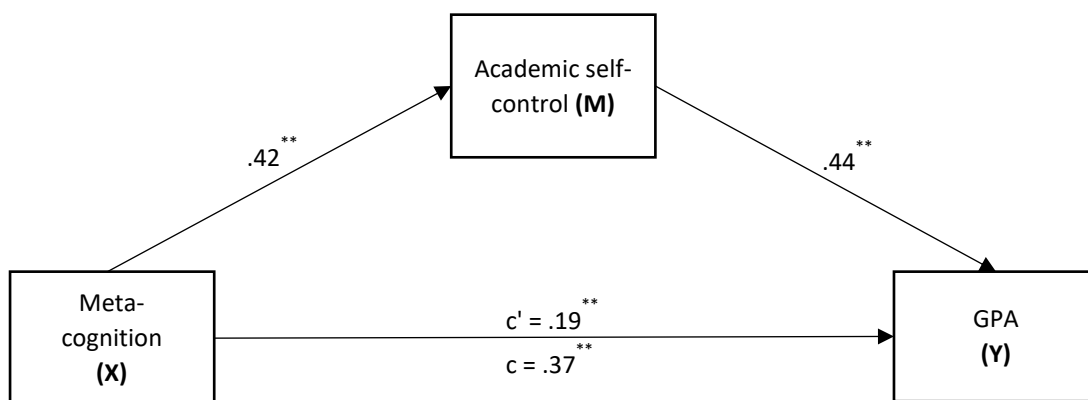
Note: **p < .001, GPA: Grade Points Average

Figure 1. Diagram of Mediation Model

The mediating role of ASC in the relationship between meta-cognition and GPA was examined among adolescents. This model showed that meta-cognition predicted ASCl ($B = .42$, $p < .001$), and ASC predicted GPA ($B = .44$, p < .001). Furthermore, the model indicated that meta-cognition had a positive direct effect ($B = .19$, $p < .001$) and indirect effect ($B = .18$, $p < .001$) on GPA. The total effect of meta-cognition on GPA is also statistically significant ($B = .37$, $p < .001$). Lately, it has been observed that this model revealed that the predictor variables accounted for 22% of the variation in GPA scores.

Table 2. Model Pathways and 95% CIs for the Paths of the Mediation Model

Effect	Estimate	SE	95% C.I. (a)		p
			Lower	Upper	
Meta-cognition ⇒ ASC	.42	.02	.36	.48	< .001
ASC ⇒ GPA	.44	.06	.32	.55	< .001
Meta-cognition ⇒ GPA	.19	.04	.01	.27	< .001
Indirect Effect	.18	.03	.13	.24	< .001
Direct Effect	.19	.04	.11	.27	< .001
Total Effect	.37	.04	.29	.46	< .001

Note: ASC: Academic Self-Control, GPA: Grade Points Average

The study examined whether the indirect effect in the tested model was statistically significant by conducting the analysis on 5000 bootstrap samples. Table 2 presents the outcomes of the estimates assessed within the 95% confidence interval. As a result, the direct and indirect effects of metacognition on academic achievement are significant, and ASC has a partial mediator role in this effect.

DISCUSSION

One of the key questions in the field of educational psychology is "Why do some students give up when they come across academic challenges, while others achieve higher grades by utilizing various strategies and persevering" (Dilmaç & Şimşir Gökalp, 2022; Mega et al., 2014). Although the responses of researchers to this question vary, the umbrella term that refers to factors that

affect academic performance other than intelligence and ability is noncognitive factors (e.g., Farrington et al., 2012; Han et al., 2022; Lee & Stankov, 2018). The term noncognitive commonly defines a broad variety of personal qualities, skills, and characteristics that represent a person's mental, emotional, behavioral, motivational, and other psychosocial propensities. (Lee & Stanko, 2018). Noncognitive factors affecting achievement include many concepts ranging from family-related factors to personality traits, self-regulation skills, and mental health (Farrington et al., 2012; Thom & Finkelstein, 2016). In the present investigation, the role of metacognition and ASC among these factors was examined. A mediation model that addresses the correlations between metacognition, ASC, and academic achievement was established hereunder, and the mediating role of ASC in the correlation between metacognition and academic achievement was tested.

The findings of the study showed that metacognition significantly predicted ASC in adolescents (H1). A study conducted by Yılmaz-Tüzün and Topçu (2007) with primary and secondary school students reported that metacognition skills and academic achievement were positively correlated. A study conducted by Young and Fry (2008) with college students found a positive association between metacognition and academic achievement. From this perspective, the finding of this research is compatible with the literature (e.g., Bağçeçi et al., 2011; Case et al., 1992; Emrahoğlu & Öztürk, 2010; Gul & Shehzad, 2012; Yenice et al., 2017). Metacognition implies a high degree of thinking that includes having control over cognitive processes related to learning and incorporates activities such as organizing the task to be learned, monitoring the steps, and assessing progress (Livingston, 2003). Students who have effective metacognitive skills monitor their learning, refresh their knowledge, and make plans for new learning (Everson & Tobias, 1998). From this perspective, metacognition as a skill that improves students' academic achievement is not a surprising consequence.

Based on the findings of the present research, metacognition significantly affected ASC in adolescents (H2). A longitudinal study conducted by Wang et al., (2021) with adolescents between the ages of 11 and 15 reported that there was a significant link between metacognition and self-control. An experimental study by Nursalam and Rozana (2022) on 6th-grade students reported that metacognitive skills improved ASC. Briefly, studies in the literature (Bahadorikhosroshahi & Habibi-Kaleybar, 2017; Chernokova, 2014; Hennecke & Bürgler, 2023) have supported the finding that metacognition significantly ASC. Self-control describes an individual's ability to manage their own behaviors and adapt them to varying situations, and direct occasions (Ekşi et al., 2019). Bandura (1989) also describes self-control as the person's capacity to control his or her own thought processes, motivations, and actions. Metacognition also represents the monitoring and controlling of thought (Martinez, 2006). Metacognition plays a crucial role in people's self-control (Flavell, 1979).

The analysis results showed that ASC directly predicted academic achievement in adolescents (H3). The related studies in the literature have supported this finding (Bertrams & Dickhäuser, 2009; Duckworth & Seligman, 2006; Duckworth et al., 2019; Li et al., 2022; Normandeau & Guay, 1998). The study performed by Dzinovic et al. (2019) on 8th-grade students reported that students with high levels of self-control achieved more academic achievement. The study conducted by Duckworth and Seligman (2006) on 8th-grade students indicated that higher academic achievement of female students compared to male students was associated with their higher level of self-control. A study carried out by Stadler et al. (2016) with college students reported that self-control significantly accounted for academic achievement. Self-control is a dynamic motivational system that allows an individual to set goals, develop and put into practice strategies to achieve these goals, and revise goals and strategies by evaluating progress (Vohs & Baumeister, 2016). From this point of view, self-control directly affects students' academic achievement (Maranges & Baumeister, 2016).

Finally, metacognition significantly predicts academic achievement in adolescents through ASC (H4). Although there is no study that examines the mediating effect of metacognition, ACS and academic achievement variables, the relationships between the variables can be explained from the statements in the literature and similar studies. Schraw and Dennison (1994) point out that metacognition involves the ability to control the individual's learning processes and emphasize that cognition and regulation can work together to support students' self-regulation processes. Based on this, it can be stated that students who have metacognitive characteristics, that is, the ability to understand and control their learning processes, will have higher levels of ASC. In the literature, metacognitive awareness is associated with self-regulatory behaviors that contribute to academic success (Zimmerman, 2002). Based on all these explanations, developing metacognitive awareness in educational settings is very important to increase students' self-control and ultimately support their academic success. Self-control is a qualification that depends on mastering metacognitive strategies (Duckworth et al., 2014). Therefore, a framework explaining the role of metacognition on self-control is necessary for an accurate understanding of self-control. There is, however, no comprehensive framework or model that illustrates the structural and functional components of metacognition before, during, and after the experience of self-control conflict exists yet (Hennecke & Bürgler, 2022). The *process model of self-control* proposed by Duckworth et al., (2016) introduced self-control strategies and drew attention that these strategies are based on metacognitive skills. The model suggested the association of self-control with academic accomplishment, as well as a number of applications that students can develop to resolve conflicts related to academic tasks. Nevertheless, the model did not address individual differences, conflict perception, or monitoring mechanisms during self-control conflict experiences (Hennecke & Bürgler, 2022). Hence, the results of the present study not only support the process model of self-control but also contribute to the model.

CONCLUSION AND RECOMMENDATIONS

The findings of the present study are important both for broadening the literature and for providing empirical evidence for the process model of self-control. However, some limitations should be taken into consideration when evaluating the results of the

present study. Secondary and high school students who attended secondary and high school in two provinces of Türkiye participated in the study. Accordingly, the results of the study cannot be generalized to all adolescents. Self-report scales were utilized to collect data in the study. There is a possibility that the participants may have acted haphazardly while responding to these scales, not paying attention, or responding in a way that misrepresents themselves to gain social appreciation. In this regard, it may be useful to employ parent-report or teacher-report scales as well as self-report scales in future studies. Also, since this was a cross-sectional study, it was not possible to gather in-depth information about the participants or to follow the participants during the process. Qualitative and longitudinal studies may be necessary in the future to eliminate such limitations. Longitudinal studies are required to draw more in-depth theoretical inferences and to better understand the links between metacognition, ASC, and academic achievement.

In conclusion, the results of the present study indicated that ASC and metacognition positively affected academic achievement and ASC played a mediating role in the correlation between metacognition and academic achievement. These results can guide school counsellors in the process of creating a comprehensive program and planning strategic interventions to improve students' academic achievement. For example, school counsellors may develop ASC psychoeducational programs for middle school and high school students and incorporate activities to improve metacognitive skills into these programs (e.g., Duckworth et al., 2014; 2016). They may also consider providing individual coaching or group counselling to adolescent students in order to help them improve ASC and metacognitive skills. Teachers can design classroom activities that require students to set goals for their future, explore internal and external sources of motivation, monitor their progress and reflect on their learning. They can also create group activities where students can share and discuss their learning strategies. Parents can support their children to reflect on and become aware of the learning strategies that work for them. They can also support the use of self-control strategies in everyday life, such as time management for studying, exploring internal and external sources of motivation, and setting limits on distractions (such as screen time).

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Statements of Publication Ethics

We hereby declare that the study has no unethical issues and that research and publication ethics have been observed carefully.

Researchers' Contribution Rate

Researchers' contribution rate First Author: Desing, Supervision, Analysis and Interpretation, Writing, Critical Review; Second Author: Data Collection, Writing, and Editing; Third Author: Data Collection, Writing

Ethics Committee Approval Information

The study was approved by the Faculty of Education Ethics Committee of Selçuk University (Date/Num: 11.07.2023-56).

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Poverty and Academic Achievement in the Light of Teachers' Experiences and Perceptions: A Phenomenological Study

Öğretmenlerin Deneyim ve Algıları Işığında Yoksulluk ve Akademik Başarı: Fenomenolojik Bir Araştırma

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Abstract

Purpose: The principal objective of this study is to elucidate the experiences and perceptions of teachers regarding poverty and academic achievement, and to ascertain the extent to which these experiences and perceptions are reflected in their professional practices. The research will analyze how teachers perceive the impact of poverty on students' academic achievement, how teachers' perceptions of poverty and academic achievement affect their teaching strategies and classroom practices, and which strategies teachers should develop to increase the academic achievement of poor students. Furthermore, the link between poverty and education will be evaluated through the eyes of teachers.

Design/Methodology/Approach: This study was conducted with a qualitative, descriptive phenomenological research design and interpretive paradigm. The aim of this approach is to explore lived experiences, events or situations as they are, and to examine how these experiences are perceived and made sense of by individuals. The study sample comprises teachers employed in the Karatay, Meram and Selçuklu districts of Konya province. Ten teachers employed at Anatolian, Science and Social Sciences High Schools, which are distinguished by their academic excellence, were selected through the criterion sampling method, which is a sub-sample of the more commonly used purposeful sampling technique in qualitative research. A focus group interview was utilized as the primary data collection instrument in the study. The data analysis of the research was conducted using a descriptive phenomenological method with the NVIVO 14 software package.

Findings: The research demonstrated that poverty has a detrimental impact on students' access to learning resources, the quality of practical education, motivational and emotional effects, academic performance and development. Conversely, it was determined that the implementation of strategies such as access to resources, academic support, motivation, and psychological assistance could prove effective in enhancing the academic performance of underprivileged students.

Highlight: In regard to the interrelationship between poverty and education, the availability of resources, learning assistance, motivation, self-assurance, and psychological and social support have been demonstrated to enhance academic performance. Poverty has a profound impact on students' access to education, learning processes and academic achievement. The attainment of success in education is contingent upon both the individual efforts of the student and the socioeconomic conditions in which they live.

Öz

Çalışmanın amacı: Bu çalışmanın temel amacı, öğretmenlerin yoksulluk ve akademik başarıya dair deneyimlerini, algılarını ve bu deneyim, algıların mesleki uygulamalarına nasıl yansıdığını ortaya çıkarmaktır. Araştırma kapsamında "öğretmenlerin yoksulluğun öğrencilerin akademik başarıları üzerindeki etkisini nasıl algıladıkları, öğretmenlerin yoksulluk ve akademik başarı algılarının öğretim stratejilerini ve sınıf içi uygulamaları nasıl etkilediği, öğretmenlerin, yoksul öğrencilerin akademik başarılarını artırmak için hangi stratejileri geliştirmeleri gerektiği" soruları ile yoksulluk ve eğitim arasındaki bağlantı öğretmenlerin gözünden değerlendirilmiş olacaktır.

Materyal ve Yöntem: Bu araştırma yaşanmış deneyimleri, olayları veya durumları olduğu gibi keşfetmeyi hedefleyen ve bu deneyimlerin bireyler tarafından nasıl algılandığını ve anlamlandırıldığını inceleyen nitel, betimsel fenomenolojik araştırma deseni ve yorumlayıcı paradigma ile yürütülmüştür. Araştırmanın örneklemini Konya ili Karatay, Meram ve Selçuklu ilçelerinde görev yapan öğretmenler oluşturmaktadır. Öğretmenler nitel araştırmada sıklıkla kullanılan amaçlı örneklemenin alt örneklemi olan kriter örnekleme alma yöntemiyle akademik başarı yönünden iyi olan "Anadolu, Fen ve Sosyal Bilimler Liselerinde" görev yapan on öğretmen seçilmiştir. Araştırmada veri toplama aracı olarak odak grup görüşmesi yapılmıştır. Araştırmanın veri analizinde NVIVO 14 paket programı ile betimleyici fenomenolojik yöntem kullanılarak analizler yapılmıştır.

Bulgular: Araştırma yoksulluğun, öğrencilerin öğrenme kaynaklarına erişimini, uygulamalı eğitim eksikliğini, motivasyon ve duygusal etkilerinin olduğunu, akademik performans ve gelişimini olumsuz etkilediğini göstermiştir. Öte yandan yoksul öğrencilerin akademik başarılarının artırılması için erişim ve kaynaklar, akademik destek, motivasyon, psikolojik destek gibi stratejilerinin kullanılması gerektiği bulgusuna ulaşılmıştır.

Önemli Vurgular: Yoksulluk ve eğitim bağlantısı açısından kaynaklara erişim, öğrenme desteği, motivasyon ve özgüven psikolojik ve sosyal destek akademik başarıyı artırmaktadır. Yoksulluk, öğrencilerin eğitime erişimlerini, öğrenme süreçlerini ve akademik başarılarını derinden etkilemektedir. Eğitimde başarıya ulaşmak, öğrencilerin yalnızca bireysel çabalarına değil, aynı zamanda içinde bulundukları sosyoekonomik koşullara bağlıdır.

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INTRODUCTION

Education is an efficacious instrument that enhances individuals' involvement in social and economic activities (O'Brien et al., 2024; Ravi, 2022). However, achieving success in education (Allen, 2024) depends not only on students' individual efforts (Akça et al., 2017) but also on the socioeconomic conditions in which they live (İnanç, 2023). The socioeconomic conditions in which students reside (İnanç, 2023) also exert a significant influence on their educational trajectory. In this context, poverty represents a significant factor that profoundly impacts students' access to education, learning processes and academic achievement (Clark & Kjellstrand, 2024). Notwithstanding the endeavors to guarantee equal opportunities in education (Kaplan & Owings, 2021), poverty persists as a multifaceted impediment that constrains students' cognitive and emotional growth (Wages, 2015). It is therefore evident that a more profound comprehension of the intricate interconnection between poverty and academic performance is imperative (Klapp et al., 2024). Teachers are the most significant stakeholders in this context, as they are directly exposed to and affected by the consequences of this relationship (Singal, 2014). Teachers engaged with students from economically disadvantaged backgrounds witness the difficulties these students face in their educational life (Terzi et al., 2023), observe their academic achievement (Kim, 2024) and develop various strategies to overcome these difficulties (Gaete & Gomez, 2019). In the literature on the subject, the education-poverty nexus (McNicholl & McNamara, 2019), the connection and effects of poverty with different variables (Hartley et al., 2024; Spada et al., 2024), education (O'Brien et al., 2024) and academic achievement (Clark & Kjellstrand, 2024) have been studied individually, but teachers' perceptions of poverty and academic achievement and the effects of these perceptions on students have not been sufficiently examined in terms of developing educational policies and practices. This situation also creates a gap in this field. In this context, focusing on teachers' experiences and perceptions on this issue (Gaete & Gomez, 2019) can provide valuable information to support efforts to ensure equal opportunities in education (Akça et al., 2017). The impact of poverty on education is not merely confined to the lack of material resources (Tierney, 2015; Zhang, 2024), but also plays a pivotal role in influencing students' motivation to learn (Newaz, 2023), their psychosocial status and perceptions of the future (Gaete & Gomez, 2019; Kaplan & Owings, 2021). Poor students often face disadvantages in their learning processes (Wages, 2015), such as emotional support (Çelik, 2023), a suitable study environment, academic achievement (Yu et al., 2018) and access to educational materials (Li et al., 2024). The role of teachers in supporting the learning processes of these students is critical in mitigating the effects of these challenges (Singal, 2014). Therefore, investigating teachers' perceptions of the link between poverty and academic achievement and how these perceptions are reflected in their teaching processes is important for world education systems (Wakuma, 2024).

In this study, a qualitative, phenomenological approach will be adopted to facilitate a comprehensive examination of teachers' perceptions of poverty and its relationship with academic achievement. Phenomenological research is a method that focuses on understanding individuals' experiences in depth (DeHart, 2023; Larsen, 2023). In this context, it provides an appropriate framework for examining teachers' personal experiences and perceptions of poverty and the effects of these experiences on their professional practices. This method will facilitate an assessment of the impact of poverty on education, encompassing both external factors (Hartley et al., 2024; Ngepah et al., 2023) and individual perceptions and experiences (Gardiner & Hajek, 2024). Teachers' experiences are of vital importance in efforts to provide equal opportunities in education and combat socioeconomic disadvantages (McNicholl & McNamara, 2019). In particular, the role of teachers in providing guidance, support and motivation to students from disadvantaged backgrounds in the learning process is of significant importance. However, the challenges faced by teachers in this process and their methods of coping with these challenges are frequently overlooked in the formulation of educational policies (Kanat et al., 2024). This study aims to address this gap by examining teachers' individual perceptions. The principal objective of this study is to elucidate the perceptions of poverty and academic achievement held by teachers and to examine the manner in which these perceptions are manifested in their professional practices. Within the scope of the research, 'how teachers perceive the impact of poverty on students' academic achievement, how teachers' perceptions of poverty and academic achievement affect teaching strategies and classroom practices, which strategies teachers should develop to increase the academic achievement of poor students' will be analyzed from the perspective of teachers. In line with the aim of understanding the link between poverty and academic achievement (Spada et al., 2024: Michael & Kyriakides, 2023) in the light of teachers' experiences and perceptions, the findings of this study will both contribute to the development of policies towards equal opportunities in education and provide practical recommendations to support teachers' professional development. Focusing on teachers' voices and experiences will provide guidance to policy makers, education administrators and education stakeholders on the link between poverty and academic achievement as a critical step towards developing more inclusive and effective strategies to combat poverty in education.

METHOD

Research Design

The principal objective of this study is to elucidate the experiences and perceptions of teachers regarding poverty and academic achievement, and to ascertain the extent to which these experiences and perceptions are reflected in their professional practices. The study was conducted in accordance with a descriptive phenomenological research design, which is one of the qualitative research methods (Creswoll & Guetterman, 2019). Phenomenological research is a research method that aims to gain an in-depth understanding of people's experiences, perceptions and meanings (DeHart, 2023). This type of research aims to explore lived

experiences, events or situations as they are and examines how these experiences are perceived and made sense of by individuals (Larsen, 2023). In addition, this research was conducted with the interpretive paradigm. The interpretive paradigm focuses specifically on examining how people perceive the world, how they make sense of their experiences, and how they shape interactions in the social context (Gunbayi & Sorm, 2020).

Sampling

The sample for this study comprises teachers currently employed in the Karatay, Meram and Selçuklu districts of Konya province. The teachers were selected from those employed at Anatolian, Science and Social Sciences High Schools, which are distinguished by their academic achievement. This was achieved through the criterion sampling method, which is a sub-sample of the more frequently used qualitative research technique of purposeful sampling. Table 1 presents the demographic information of the teachers who participated in the study.

Table 1. Demographic information of the participants

Participants	Gender	Title	Duty Station	Branch
Participant A	Male	Expert Teacher	Karatay	Turkish Language and Literature
Participant B	Female	Head Teacher	Meram	Mathematics
Participant C	Male	Expert Teacher	Selçuklu	Guidance
Participant D	Male	Head Teacher	Meram	Chemistry
Participant E	Female	Expert Teacher	Karatay	Physics
Participant F	Female	Expert Teacher	Meram	Biology
Participant G	Female	Expert Teacher	Karatay	Geography
Participant H	Male	Teacher	Selçuklu	Music
Participant I	Female	Head Teacher	Selçuklu	History
Participant J	Male	Head Teacher	Selçuklu	Physical Education and Sport

Upon analysis of Table 1, it becomes evident that a total of ten teachers participated in the research. Teachers are affiliated with the following academic departments: Turkish Language and Literature, Mathematics, Guidance, Chemistry, Physics, Biology, Geography, Music, History, Physical Education and Sports. The majority of the teachers who participated in the study were specialists and head teachers.

Data Collection Tool

In the study, a focus group interview was selected as the data collection instrument. The focus group interview is a research tool that enables the researcher to gain an understanding of the thoughts and perspectives of a larger group of participants through the use of group interaction (Denzin & Lincoln, 2018). The interview format enables the exploration of diverse perspectives on a given topic, facilitating the development of ideas through group interaction (Creswell, 2015; Flick, 2022). The study was moderated by the researchers. The focus group interview was conducted in a manner that fostered sincerity and comfort for the teachers, allowing them to express their views on the subject matter in an open and relaxed manner. With the consent of the participants, the interviews were audio-recorded.

Data Analysis

NVIVO 14 package program was used in the data analysis of the research. Gunbayi (2023) divides data analysis in qualitative research into four categories as "thematic analysis, descriptive analysis, content analysis and analytical generalization". In this study, analyses were made using these categories and Giorgi et al. (2017) descriptive phenomenological method. In order to minimize coding errors during the process of creating themes in the research, transcript codes were examined by five experts and subjected to Fleiss Kappa reliability analysis. As a result of the analysis, it was determined that the reliability coefficient between the coders was [K=.872, p=.001]. This result shows that the agreement between the coders is quite high (Gwet, 2021). For ethical reasons, participants were coded with the letters 'A, B, C, D, E, F, G, H, I, and J'.

FINDINGS

The themes, categories and codes related to how teachers perceive the impact of poverty on students' academic achievement are presented in Table 1, the themes, categories and codes related to how teachers' perceptions of poverty and academic achievement affect teaching strategies and classroom practices are presented in Table 2, the themes, categories and codes related to which strategies should be developed to increase the academic achievement of poor students are given in Table 3, and the themes, categories and codes related to how academic achievement will be affected when poverty is reduced in the light of teachers' experiences and perceptions are given in Table 4.

Table 2. Themes, categories and codes related to the effect of poverty on students' academic achievement

Themes	Category	Code	Participants
Lack of Access to Learning Resources	Lack of Material	Lack of books, test books, microscopes, maps, sports equipment	A, B, F, G, J
	Lack of Technology	Digital resources, computer, internet, geographical information systems	B, E, G
Lack of Applied Training	Laboratory Studies	Chemistry and physics experiments, lack of biology equipment	D, E, F
	On-site Learning	Not being able to participate in historical sites, nature trips, geography activities	I, F, G
	Art Education	Not being able to participate in instrument, music lessons and clubs	H
Motivation and Emotional Effects	Self-confidence and Social Environment	Lack of self-confidence, social isolation, feeling of being left behind	C, H, J
	Stress and Hopelessness	Stress due to financial difficulties, hopelessness, lack of motivation	C
Academic Performance and Development	Effects on Course Success	Lack of interest in reading, mathematics, science and history	A, B, D, F, I
	Cognitive and Physical De	Lack of nutrition, inability to participate in sports activities	A, B, C, D, E, F, G, H, I, J

When the themes, categories and codes related to the effects of poverty on students' academic achievement are analyzed in Table 2, the theme of "Lack of Access to Learning Resources" from the categories of lack of materials and lack of technology; the theme of "Lack of Applied Education" from the categories of laboratory studies, on-site learning and art education; the theme of "Motivation and Emotional Effects" from the categories of self-confidence and social environment, stress and hopelessness; and the theme of "Academic Performance and Development" from the categories of effects on course success, cognitive and physical development. Teachers' opinions on the subject are given below.

[...poverty has a significant impact on students' development of language skills. Especially in order to acquire the habit of reading, students need access to a variety of books, magazines and literary works. However, poor students often do not have access to these resources. The lack of bookshelves in their homes or limited access to libraries has a direct negative impact on their vocabulary development and reading comprehension skills. In addition, their written expression skills are limited, as they need a large vocabulary and literary background to write effectively. This situation negatively affects not only their academic success but also their life skills in general, leading to a loss of self-confidence. A].

[...mathematics is an area where students develop abstract thinking and problem-solving skills. However, poor students often lack sufficient motivation during lessons. There are several reasons for this: Firstly, they do not have a quiet study space at home. Secondly, families do not have the financial means to invest in educational materials. For example, students who do not have access to resources such as test books, examples with solutions or subscriptions to online platforms have difficulty in making up for their deficiencies. In addition, not being able to attend private lessons or study centers is another factor that increases the achievement gap. When all these factors come together, poverty seriously lowers the level of success in mathematics. B].

[... not only the physical but also the emotional and psychological effects of poverty are profound. Students in financial difficulties often tend to isolate themselves from their social environment. Lack of self-confidence, feelings of inadequacy and hopelessness about the future seriously undermine their academic motivation. In addition, communication problems, which are common in families struggling with economic problems, cause students to seek support at school. Some students start to be absent because they cannot carry these emotional burdens. In the long run, this situation deeply affects both the academic and personal development of students. C].

[...chemistry is a subject that students can learn through experimentation and visualization. However, poor students do not have enough access to laboratory facilities at school or do not have the necessary materials to conduct even simple experiments at home. The materials used in chemistry classes can often be costly, putting poor students at a disadvantage. In addition, not being able to participate in science centers or science activities reduces their interest and motivation. Such shortcomings can have a negative impact on students' achievement in the course and may also lead to a decrease in their interest in science. D].

[...in order to learn physics, theoretical knowledge should be supported by practical applications. However, poor students have great difficulties in participating in laboratory studies or experiments. This deficiency causes physical concepts to remain abstract and students have difficulty in understanding these subjects. For example, the inability to obtain even the necessary equipment for a simple experiment deprives students of the opportunity to learn through experience. In addition, lack of access to technology prevents students from doing research on physics topics and utilizing interactive resources such as computers and the Internet. E].

[...biology aims to increase students' understanding of nature and their scientific curiosity. However, poverty is a major obstacle to this process. Students who cannot access basic laboratory materials such as microscopes and slides are deprived of the practical aspect of this course. In addition, participation in activities such as nature trips and science camps, which are frequently organized in the biology course, becomes almost impossible for poor students due to financial reasons. This situation directly affects students' learning process and reduces their interest in science. Poverty not only creates a lack of materials, but also suppresses students' self-confidence and sense of curiosity. F].

[...the use of visual materials in geography lessons and on-the-spot learning make the information more permanent. However, students growing up in poverty generally cannot access materials such as atlases and maps. Not being able to benefit from technological resources also makes this situation more complicated. For example, students who cannot use digital maps or geographical information systems remain away from modern learning methods. In addition, excursions to historical or natural sites in geography lessons are no more than a dream for these students due to economic reasons. G].

[...music is an important subject for students to develop creative thinking and emotional expression skills. However, poor students find it difficult to buy instruments and receive the necessary training to develop in this field. Often, they are unable to attend individual lessons or music clubs, which are essential for music education. This situation causes students to lose interest in music over time and not realize their potential. In addition, a student who cannot afford an instrument due to economic reasons may feel behind his/her friends and this damages his/her self-confidence. H].

[...in history lessons, supporting the information with visual materials and visiting historical places makes learning much more effective. However, poor students find it difficult to participate in trips organized to historical places. The lack of access to documentaries, films or special history books reduces students' interest in the subject. This not only leads to a lack of interest in history, but also affects students' general cultural knowledge. It is also observed that poverty limits students' imagination and analytical thinking skills. I].

[...students' participation in physical activity in physical education and sports classes is important for healthy development and team spirit. However, poor students have serious problems in accessing sports equipment. For example, a student's lack of sports shoes or uniform prevents him/her from actively participating in classes. In addition, poor students are often unable to develop their talents because they cannot participate in sports clubs or professional training. This situation negatively affects both physical development and self-confidence, and these students feel behind their friends J].

Table 3. Themes, categories and codes related to how poverty and academic achievement perception affect teaching strategies and classroom practices

Theme	Category	Code	Participant
Poverty and Education Linkage	Access to Resources	Classroom library, no-cost resources	A, B, C, D, E, F, G, H, I, J
		Digital and visual materials	A, B, C, D, E, F, G, H, I, J
	Learning Support	Inclusive strategies, one-to-one support	A, B, C, D, E, F, G, H, I, J
		Creative writing, working in small groups	A, E, G
	Motivation and Self-confidence	Achievement awards, positive feedback	A, B, C, D, E, F, G, H, I, J
		Opportunities to showcase talent	H, J
	Psychological and Social Support	Psychological interview, positive environment	A, B, C, D, E, F, G, H, I, J
	Academic Success	Additional work, simplification	A, B, C, D, E, F, G, H, I, J
		Simulations and virtual tours	A, B, C, D, E, F, G, H, I, J

When the themes, categories and codes related to how the perception of poverty and academic achievement affect teaching strategies and classroom practices are analyzed in Table 3, the theme of 'Poverty and Education Linkage' was reached from the categories of access to resources, learning support, motivation and self-confidence, psychological and social support, and academic achievement. The opinions of the teachers on the subject are given below.

[...since poverty negatively affects students' language development and academic achievement, I tried to use more inclusive and supportive strategies in my lessons. For example, instead of expecting my students to buy books, I created a class library and offered books at different levels. I also tried to make it easier for students to understand literary texts by using visual materials and digital resources in my lessons. Since I realized that students living in poverty had difficulty in expressing themselves, I gave more space to creative writing activities and tried to increase their self-confidence through such activities. Creating a positive environment in the classroom is very important to reduce the anxiety of these students and make them feel more valuable. A].

[...for students experiencing poverty in mathematics lessons, I simplified the course materials and preferred to work with inexpensive resources. For example, I took care to keep the examples on the board accessible to everyone and to simplify complex concepts. I also spent more time on in-class reinforcement activities because I knew that students did not have access to outside tutoring or additional resources. Taking into account the loss of motivation brought about by poverty, I often encouraged them to achieve small successes and encouraged them through rewards. B].

[...when I was working with students living in poverty, I was guiding them by taking their psychological conditions and social concerns into consideration. First of all, I was trying to understand their needs by conducting one-to-one interviews with these students. Together with my fellow teachers, we were developing strategies to prevent the exclusion of these students in the classroom environment. In order to increase academic achievement, I organized motivational activities and advised students to set attainable goals. I also guided families by researching opportunities such as scholarships and support programs. In order to reduce the obstacles created by poverty, I paid attention to activities that highlighted students' strengths and increased their self-confidence. C].

[...laboratory studies have an important place in chemistry course, but poor students may experience disadvantages due to lack of materials. To compensate for this situation, I conducted laboratory experiments in groups and ensured that resources were shared by the class. I also emphasized experiments that could be carried out with inexpensive and simple materials. I tried to make use of technological resources such as videos, simulations and digital tools to make theoretical knowledge more comprehensible to students. Knowing the negative impact of poverty on motivation, I constantly gave positive feedback to encourage these students and increase their participation in lessons. D].

[...in physics lessons, experiments and visual materials are of great importance for students to understand abstract concepts. However, poverty can prevent students from actively participating in these processes. For this reason, I made experimental materials available for common use in the classroom and preferred experiments with low-cost materials that could be found at home. For students who did not have access to technological resources, I took care to practice more in the classroom. In order to increase the interest of students in poverty in physics lessons, I made the subjects more concrete by using examples from daily life. I also provided one-to-one support by doing additional studies to ensure that these students did not fall behind. E].

[...in biology lessons, it is very important for students to learn through observation and experimentation. However, poor students may be deprived of activities such as laboratory and excursions. For this reason, I tried to visualize the topics by using digital microscope images, animations and videos in the classroom. I also organized in-class simulations for students who could not participate in nature trips due to budgetary constraints. F].

[...maps, atlases and visual materials are of great importance in geography lessons. However, since poor students do not have access to these resources, I was careful to use digital maps and free materials in the classroom. I tried to ensure that all students learn equally by simulating excursion and observation activities in the classroom. I also organized small group activities to encourage the active participation of these students in the learning process. In order to reduce the impact of poverty on motivation, I tried to make geography lessons more fun and interactive, and I personalized the topics by giving examples from their own environment to students. G].

[...the ability to play an instrument has an important place in music lessons. However, poor students may experience disadvantages in this area because they cannot provide their own instruments. For this reason, I ensured the shared use of school instruments in the classroom and took care to distribute such resources equally. I also organized additional lessons for poor students to develop their musical skills and tried to interest them in activities that did not require any cost, such as body percussion. H].

[...visualizing and dramatizing historical events in history lessons facilitates the learning process. However, students living in poverty often do not have access to such materials. For this reason, I used interactive methods in the classroom and tried to support everyone's learning by preparing visual presentations and videos. For students who could not participate in excursions or visits to historical sites, I organized virtual tours or simulations in the classroom. I].

[...in physical education classes, poor students may have difficulties in accessing sports equipment. I also planned games and exercises based on individual efforts to develop students' physical abilities. To prevent poverty from demotivating students, I encouraged every student, regardless of their achievements, and tried to instill the spirit of working together through team games. I allowed students to express themselves, taking into account that sport provides not only physical but also emotional balance. J].

Table 4. Themes, categories and codes related to strategies to be developed to increase the academic achievement of poor students

Theme	Category	Code	Participant
Access and Resources	Training Materials	Classroom library, digital resources	A, B, D, E, F, I, G
	Cost-Free Solutions	Free materials, shared use	B, D, E, F, H, J
Academic Support	Facilitating Learning	Group work, one-to-one support	A, B, D, E, F, G
	Visualisation	Simulations, visual content	D, E, F, G, I
Motivation	Increasing Self-Confidence and Interest	Positive feedback, rewarding	B, I, H, J
Psychological Support	Social Engagement	One-to-one interviews, group work	C, A, J

When the themes, categories and codes related to the strategies that should be developed to increase the academic achievement of poor students are analyzed in Table 4, the theme of 'Access and Resources' from the categories of educational materials and cost-free solutions; the theme of 'Academic Support' from the categories of facilitating and facilitating learning; the

theme of 'Motivation' from the category of increasing self-confidence and interest; and the theme of 'Psychological Support' from the category of social participation. The opinions of the teachers on the subject are given below.

[...it is of great importance to provide access to more resources in the classroom to increase the academic achievement of poor students. Therefore, I created a classroom library for my students and provided information about books that can be borrowed from local libraries. I also suggested cost-free activities such as creative writing exercises and journaling to improve their written expression skills. In literature classes, I organized word games to increase students' vocabulary and encouraged them to analyze texts from their own perspectives. It is often difficult for poor students to express themselves, so I emphasized individual work such as writing poems and stories. I tried to create an equal learning environment by sharing digital content in the classroom for students without access to technology. A].

[...to improve the achievement of poor students in mathematics classes, I promoted free and accessible resources. I downloaded free tests and worksheets from various online platforms and shared them in the classroom. I helped students reinforce the topics they had difficulty understanding by working one-on-one. I also organized group work to improve their problem-solving skills. These students are often reluctant to participate in class, so I tried to create an encouraging environment for them. I made the lessons more fun with gamified learning methods and gave them constant motivational feedback to improve their achievement. B].

[...an effective counselling process for poor students plays a critical role in increasing their academic success. Firstly, I was conducting regular one-to-one interviews to understand the needs of the students and direct them to the right resources. In these interviews, I was trying to motivate the students and help them set goals for the future. I was informing them to benefit from scholarships, free courses and social assistance. In the classroom environment, I organized socialization activities for students to express themselves. I aimed to increase the self-esteem of students who had self-confidence problems due to poverty by giving them responsibility in activities that would highlight their success. C].

[...to increase the success of poor students in chemistry lessons, I emphasized experiments that could be done with simple and low-cost materials. Instead of assignments requiring experiments at home, I reinforced the subjects with group work in the classroom. I also compensated for the lack of a laboratory to some extent by using engaging videos and simulations related to science. For students who did not have access to technological tools, I made the information more concrete through interactive methods in the classroom. I tried to increase my students' interest in science by directing them to free science festivals and competitions. I often gave positive feedback and rewarded their small successes to make these students feel competent. D].

[...in physics lessons, I used examples from daily life and cost-free experiments to facilitate the understanding of abstract concepts. In order to show students that success in physics does not depend on financial resources, I suggested projects that could be done with materials available at home. In addition, for students who did not have access to technology, I showed videos in the classroom and tried to increase physical experiences. By organizing group work, I helped poor students to express themselves more easily in groups. To increase the motivation of students in poverty, I often helped them set goals and encouraged them to participate in physics competitions. E].

[...in biology lessons, I used visual materials and digital content more often in the classroom to ensure the active participation of poor students in the learning process. For students who did not have the opportunity to conduct experiments at home, I organized simple and low-cost experiments in the classroom. I also tried to make activities such as nature walks and observation activities free and accessible to increase students' interest in biology. In order to make biology topics more concrete, I shared the resources I obtained from online platforms in the classroom. I conducted one-to-one lessons and reinforcement activities to make up for the deficiencies of these students. I also encouraged students through activities such as group presentations to increase their self-confidence F].

[...in order to increase the success of poor students in geography lessons, I used free digital versions of materials such as maps and atlases. I also tried to compensate for their lack of access to technology by using online tools that simulate geographical events with my students in the classroom. Instead of field trips, I organized virtual tours in the classroom and reinforced the subjects with visual materials. To increase interest in geography, I personalized the subjects based on the characteristics of the region where the students lived. I organized additional study hours for poor students to make up for their deficiencies and took care to answer their questions one-to-one G].

[...in music lessons, to increase the success of poor students, I concentrated on activities such as practicing with free instruments and body percussion. I made the school's musical instruments available for common use in order to overcome my students' lack of instruments. I also reduced students' individual performance anxiety by organizing collective music activities. In order to connect them more to music, I organized small concerts and events where they could showcase their talents. I directed them to free activities and scholarship programs so that financial constraints would not reduce their interest in music. H].

[...in history lessons, I used documentaries, videos and online content in the classroom to enable students to benefit from visual resources. I prepared virtual tours and interactive presentations for students who could not participate in historical site visits. I shared the materials I created in the classroom for students who could not access history books due to financial reasons. I also organized dramatic reenactments and role-playing activities to make history lessons more interesting. In order to increase

the success of poor students in history lessons, I supported them in teams by doing small group work and made them more self-confident. I].

[...to increase the success of poor students in physical education classes, I emphasized low-cost activities and group games. For students who did not have access to sports equipment, I made the school's equipment available for shared use. I also organized individual activities for poor students to discover their talents in sports. I was working to direct them to sports clubs and inform them about scholarship opportunities. In order to increase self-confidence in lessons, I recognized successes, even if small, and allowed them to express themselves in teamwork. In this way, I was trying to contribute to students' emotional as well as physical development through sports. J].

Table 5. Themes, categories and codes related to how academic achievement will be affected when poverty is reduced

Theme	Category	Code	Participant
Access to Education Resources	Reading and Research	Access to books, magazines, newspapers	A, I
	Course Materials	Laboratory, map, atlas	D, F, G
	Technological Tools	Educational software, projection devices	B, E, G
Academic Success	Learning Environment	Work area, desk	B
	Experience and Observation	Nature trips, experiments	D, F, G
	Additional Support	Tutoring, support	B, H
Motivation and Interest	Critical Thinking	History and cultural events	I, G
	Success and Self-Confidence	Feedback, rewarding	A, C, J
Physical Support	Health and Nutrition	Nutrition, shelter	D, E, F
	Psychosocial Support	Counselling, stress reduction	C
Arts and Sport	Artistic Activities	Instrument, music activities	H
	Physical Activities	Sports equipment, teamwork	J

When the themes, categories and codes related to how academic achievement will be affected when poverty is reduced are analyzed in Table 5, the theme of 'Access to Educational Resources' was found from the categories of reading and research, course materials and technological tools; the theme of 'Academic Achievement' from the categories of learning environment, experience and observation, additional support; the theme of 'Motivation and Interest' from the categories of critical thinking, achievement and self-confidence; the theme of 'Physical Support' from the categories of health and nutrition, psychosocial support; and the theme of 'Art and Sports' from the categories of artistic activities and physical activities. The opinions of the teachers on the subject are given below.

[...poverty has a direct effect on students' cultural capital. Access to reading materials such as books, magazines and newspapers is limited, and this situation negatively affects students' vocabulary and language skills. If poverty is reduced, students will have the opportunity to read more books, access a variety of literature and participate in cultural activities. This would increase their critical thinking skills, expressive abilities and academic achievement. In addition, better nutrition and housing conditions increase students' mental and physical energy levels and have a positive impact on their learning process. A].

[...maths often deals with abstract concepts and requires a deep understanding with regular repetition. Poverty negatively affects achievement by limiting students' extracurricular study environments. For example, without a suitable desk or a quiet environment, it is difficult for them to focus on attention-intensive subjects such as maths. With reduced poverty, students can access not only course materials but also tutoring or support programs. This allows them to catch up on missing subjects and increase their self-confidence. Also, the use of technological tools (e.g. graphing calculators, educational software) becomes more widespread, which improves achievement in maths. B].

[...poverty seriously affects the psychosocial situation and motivation of students. Poverty can cause anxiety, stress and fear of the future. This makes it difficult to focus on studies and lowers overall academic achievement. If poverty is reduced, students' emotional health and self-confidence are improved. They will also have higher expectations towards their career goals and be able to participate in activities where they can improve their social skills. More positive and effective planning can be done with students in counselling processes, which contributes to both their academic and personal development. C].

[...experimentation and observation are of great importance for chemistry lessons. However, poor students often find it difficult to access laboratory equipment, experimental materials or specialized course materials. If poverty is reduced, schools can use laboratories more actively and students can improve their scientific thinking and problem-solving skills. Also, when students' nutritional status improves, their cognitive abilities increase, which allows them to perform better in subjects that require analytical thinking, such as chemistry. D].

[...experiments and technological tools are as important as theoretical knowledge in physics courses. However, poverty can limit students' access to physics laboratories and make abstract concepts difficult to understand. If poverty is reduced, more experiments with modern equipment can be conducted in schools and students can more easily integrate science into their lives.

In addition, better living conditions increase students' interest in physical phenomena in everyday life and increase their motivation to learn. E].

[...biology classes require observation and experience of natural life. Poverty restricts students' access to laboratory materials as well as their participation in nature trips or activities in biodiversity sites. If poverty is reduced, students would have greater access to such experiences. In addition, their level of nutrition and health, necessary to understand the functioning of biological systems, would increase, which would reflect positively on their cognitive capacities. F].

[...materials such as maps, atlases, projection devices have an important place in geography lessons. However, poor students may have difficulty in understanding the lessons because they cannot access these resources. Reducing poverty increases access to these materials and strengthens the visual and interactive aspects of the lesson. In addition, by offering activities such as nature trips or cultural tours, students can be shown more concretely how geography touches life. G].

[...music education often requires access to instruments and individual study. Poor students often do not have access to these instruments and therefore cannot benefit from music education. If poverty is reduced, students have access to musical instruments and private lessons, enabling them to develop their talents. At the same time, participation in music activities increases their motivation, which indirectly has a positive impact on their academic achievement. H].

[...chronological thinking and analytical reasoning skills are important in history lessons. However, due to poverty, students cannot access history books, documentaries or museums. If poverty is reduced, students can get concrete learning opportunities by visiting historical sites. This increases their interest in history and gives them a better understanding of the past. Also, participation in social and cultural activities makes history lessons more meaningful. I].

[...poverty negatively affects students' physical activity by limiting their access to sports equipment. Poor nutrition and low living standards also reduce physical performance. If poverty is reduced, students can participate more in sporting activities where they can improve both their physical and mental health. This also improves skills such as discipline, teamwork and leadership. Besides the physical benefits of sport, it is also known to contribute indirectly to students' academic motivation. J].

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In terms of the impact of poverty on students' academic achievement, teachers have indicated that poverty restricts students' access to learning resources, which in turn affects their academic achievement. A lack of resources, including materials and technology, prevents students from receiving an education with adequate resources. In particular, the lack of educational materials, including books, laboratory resources and digital resources, impedes students' ability to engage in more productive learning opportunities. Moreover, the absence of practical training represents an additional obstacle to students' ability to gain a comprehensive understanding of the subject matter. The absence of practical activities, such as laboratory work, on-site learning and art education, hinders students' capacity to consolidate and apply their theoretical knowledge. Furthermore, poverty is also associated with motivational and emotional effects. This finding is consistent with those of previous studies (Wages, 2015; McNicholl & McNamara, 2019; Wang et al., 2024; Zhang, 2024). The lack of self-confidence, social isolation and stress experienced by students due to financial difficulties create psychological barriers that directly affect their success (Spring, 2021; Ravi, 2022). Conversely, the inability of impoverished students to meet their basic needs can also have a detrimental impact on their physical development (Pal, 2024). This situation is reflected in their cognitive development as well as their academic achievement (Allen, 2024; Kim, 2024; Newaz, 2023; Wakuma, 2024). Regarding the effect of poverty and academic achievement perception on teaching strategies, educators strive to implement a range of teaching strategies with the aim of reducing the impact of poverty on students' educational experiences. The incorporation of varied classroom materials and the utilization of digital resources to facilitate access to resources can ensure that students have enhanced opportunities for equitable education (Kaplan & Owings, 2021; Spring, 2021; Ravi, 2022). Furthermore, learning support strategies facilitate access to additional assistance in areas where students may require improvement (Kim, 2024). In addition to inclusive teaching strategies, the implementation of alternative methods, such as one-to-one support and group work, can enhance the efficiency of students' learning processes (O'Brien et al., 2024). Teachers also seek to enhance students' self-confidence by offering rewards for success, positive feedback, and opportunities for students to demonstrate their abilities, thereby providing motivation (Ravi, 2022). Psychological and social support is crucial for addressing the emotional needs of underprivileged students and fostering greater motivation to attend school (Varlık, 2024). Such support has the potential to positively impact students' academic achievement. This situation is analogous to the findings of other studies, including those by Clark & Kjellstrand (2024), Klapp et al. (2024), and Michael & Kyriakides (2023).

Regarding the strategies that should be developed to increase the academic achievement of poor students, teachers suggested increasing access to educational materials and resources to reduce poverty. This is similar to (Gardiner & Hajek, 2024; Hartley et al., 2024; Ngepah et al., 2023). Cost-free solutions, free materials and shared use stand out as an important strategy for ensuring equality in education. The effect sizes of the studies in Kaya & Erdem (2021)'s study on academic achievement are similar to the findings of this research. Furthermore, pedagogical approaches that incorporate group work, one-to-one support, and visualisation have been demonstrated to enhance students' academic achievement (Michael & Kyriakides, 2023). The provision of psychological support and opportunities for social inclusion for students from disadvantaged backgrounds is also an important

strategy. With regard to the effect of poverty reduction on academic achievement, it can be observed that students are able to gain easier access to educational resources when poverty is reduced. The provision of additional resources, including reading and research materials, course materials, and technological tools, can facilitate enhanced educational outcomes for students (Gardiner & Hajek, 2024; Hartley et al., 2024). Furthermore, ensuring students have access to adequate health and nutrition support is crucial for their holistic development, which in turn directly impacts their academic success (Allen, 2024; Wakuma, 2024). The incorporation of art and sports activities into the curriculum can facilitate students' overall achievement by promoting their physical and psychological development.

As a result, combating poverty is a critical factor in improving students' academic achievement. The strategies suggested by teachers cover a wide range from access to resources to motivation and psychological support. Educational policies and practices should take these strategies into account to combat poverty and increase students' academic achievement. It shows that teachers perceive the effects of poverty on students' academic achievement in different dimensions and need to develop various strategies to combat poverty. Teachers stated that factors such as lack of materials, difficulties in accessing technology, lack of participation in practical education and artistic activities negatively affect students' learning processes. In addition, students' lack of motivation, low self-confidence and emotional states such as stress also hinder their academic success. To mitigate these negative effects, teachers recommend increasing access to educational materials and digital resources, inclusive teaching strategies and psychological support. It was emphasised that strategies such as group work, one-to-one support and achievement rewards should be developed to increase the academic achievement of poor students. On the other hand, it was stated that with poverty alleviation, if students have access to educational resources and a healthy learning environment, their academic achievement will increase. Combating poverty can positively affect academic achievement by providing students with a better learning environment both physically and psychologically. Based on these results, the following suggestions are made for researchers for further research.

Suggestions for Future Research

1. Poor students' lack of access to educational materials and technology has a significant impact on their academic achievement. Therefore, education policy makers should work on increasing access to digital resources and technological tools and develop strategies to eliminate digital inequalities in education.

2. It was noted that students from disadvantaged backgrounds require greater assistance to succeed in an educational setting. It would be beneficial for decision-makers to examine the effectiveness of inclusive education strategies and evaluate the impact of group work and one-to-one support on academic achievement. Furthermore, it is recommended that schools provide additional psychological and social support.

Suggestions for Researchers

During the research it was determined that there are research gaps in the long-term effects of poverty on education, evaluation of school-social support collaboration and monitoring of poverty alleviation policies. Therefore, the fulfilment of the following suggestions by the researchers will fill the gaps in the literature.

1. Research should be conducted that examines the long-term effects of poverty on students' educational lives. These studies should look not only at academic performance but also at how poverty affects students' future labor force potential.

2. Poverty appears to play an important role in social environmental factors that negatively affect education. Researchers should examine how schools can develop more comprehensive support systems in collaboration with local authorities, social services and families, and explore the role of out-of-school support in education.

3. The success of education policies and anti-poverty strategies can have a direct impact on the academic achievement of pupils. Researchers should provide data and analysis that contribute to the development of more effective policies by evaluating the impact of anti-poverty projects.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

Adem Çilek: Writing – review & editing, Writing – original draft, Project administration, Investigation, Data curation, Conceptualization. Tarkan Düzgünçınar: Writing – review & editing, Writing – original draft, Conceptualization. Savaş Varlık: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Researchers' contribution rate

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

Ethics Committee Approval Information

Since this research was conducted before 2020, ethics committee permission was not obtained.

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How to be a good science teacher? Teacher practices in the perspective of seven principles for good practice

İyi bir fen bilimleri öğretmeni nasıl olunur? İyi bir eğitim ortamı için yedi ilke perspektifinde öğretmen uygulamaları

Seda Okumuş[1]

Abstract

Purpose: The study aims to determine the practices and suggestions of science teachers toward seven principles for good practice.

Design: The research used a case study design. 73 science teachers (43 women and 30 men) working in different areas of Türkiye participated in this research. The researcher developed an open-ended questionnaire (Questionnaire of Seven Principles-QSP) to collect data. The frequency and percentage values of the answers were examined, and content analysis was made.

Findings: When evaluated according to gender, school type, experience, and region variables, science teachers had low knowledge about the seven principles. However, they practiced different practices related to each principle in and out of the classroom. In addition, as their experience increased, they had more social activities, valued communication with the family, and practiced more in the classroom.

Highlights: This study aims to determine what practices science teachers use to provide good practice and what suggestions they have. The results are important for improving the quality of science education.

Öz

Çalışmanın amacı: Araştırmanın amacı fen bilimleri öğretmenlerinin iyi bir eğitim ortamı için yedi ilkeye yönelik uygulama ve görüşlerinin belirlenmesidir.

Yöntem: Araştırmada özel durum çalışması deseni kullanılmıştır. Araştırmaya Türkiye'nin farklı bölgelerinde görev yapan 73 (43 kadın, 30 erkek) fen bilimleri öğretmeni katılmıştır. Veri toplamak amacıyla araştırmacı tarafından geliştirilen açık uçlu bir anket (Yedi ilke anketi) kullanılmıştır. Verilerin analizi için fen bilimleri öğretmenlerinin verdikleri cevapların frekans ve yüzde değerlerine bakılmış ve içerik analizi yapılmıştır.

Bulgular: Araştırmada cinsiyet, okul türü, tecrübe ve bölge değişkenlerine göre değerlendirildiğinde fen bilimleri öğretmenlerinin "yedi ilke" kavramı ile ilgili düşük bilgi sahibi oldukları görülmüştür. Bununla birlikte, öğretmenlerin her bir ilke ile ilgili sınıf içi ve sınıf dışında farklı uygulamalar yaptıkları görülmüştür. Ayrıca fen bilimleri öğretmenlerinin tecrübesi arttıkça daha fazla farklı sosyal aktiviteler yaptırdıkları, aile ile iletişime önem verdikleri ve sınıf içinde daha çok uygulama yaptıkları belirlenmiştir.

Önemli Vurgular: Çalışmada fen bilimleri öğretmenlerinin iyi bir eğitim ortamını sağlamada ne gibi uygulamalar yaptıkları ve nasıl önerilerinin olduğunun belirlenmesi amaçlandığı için fen eğitiminde kalitenin artırılması adına bu çalışmanın sonuçlarının önem arz ettiği düşünümektedir.

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INTRODUCTION

Education is an important area that all states emphasize to pass on the cultural heritage of societies to future generations and raise individuals who benefit society. Schools aim to teach science, social studies, and language and raise good citizens. Therefore, improving the quality of education and training is essential in teaching and education. In this context, "Seven Principles for Good Practice- SPGP" was created by Chickering and Gamson to improve the quality of undergraduate education in 1987. The SPGP includes encouraging contact between students and faculty, developing reciprocity and cooperation among students, encouraging active learning, giving prompt feedback, emphasizing time on task, communicating high expectations, and respecting diverse talents and ways of learning (Chickering & Gamson, 1987).

The SPGP was created mainly to increase the quality of undergraduate education. However, it can also be applied to other educational levels. For this purpose, instead of student-faculty interaction in the first principle, the expression student-school (such as teacher, administration) can be used (Okumuş & Doymuş, 2020). Other principles can be used equally at all educational levels. Çavdar (2016) and Okumuş (2017) determined that the SPGP is effectively applied in secondary school science lessons. Increasing the interaction of students with the school (teachers, administrators, etc.), expressed in the first principle of the SPGP, helps the student to be more willing to go to the school. Also, the first principle makes it easier for the students to express themselves more comfortably in the school environment. When faced with any problem, students share it with their teachers or school administration more comfortably. This situation enables cooperation with the school administration in solving students' problems. In addition, the high student-school interaction makes it easier for the students to adapt to the school, especially in the first years. Regarding teachers, students' correct communication with the teacher allows the teacher to get to know the student better (Bolliger & Martin, 2018; Jensen & Bennett, 2016; Taylor et al., 2020).

Peer learning is one of the critical issues emphasized in education. Students may only sometimes ask the teacher about parts, thoughts, or questions about the subject that they need help understanding. This situation is common, especially for shy students. In this context, peer learning based on students' learning from each other comes to the fore. Because students express themselves more comfortably to their friends (Bishoff, 2010; Okumuş, 2017). Collaboration of students during the peer learning process makes it easier for them to learn the subject and helps them express themselves more comfortably. Accordingly, the cooperation of students in the lessons also increases the quality of education and training (Shoval, 2011). This situation also makes it easier for students to collaborate and share their knowledge, resources, and experiences (Bolliger & Martin, 2018; Tanis, 2020). Johnson (2014) stated that working in cooperation with students away from competition ensures their social development and protects students from isolation.

The third principle of the SPGP is to ensure active learning. Active learning involves the students' participation in the learning process and being responsible for their learning (Al-Furaih, 2017; Hathaway, 2014). According to constructivist philosophy, it is essential for students to actively participate in the learning process so that they can structure information correctly in their minds. From this perspective, the students must direct the learning process for effective teaching. The information becomes memorized because the individuals learn better what they do. Students should talk, write about what they have learned, relate the topic to their past experiences, and apply it to their daily lives. Accordingly, teaching methods and techniques that will actively involve students in the process, such as projects, discussions, and collaborative work, will also increase the quality of teaching (Al-Furaih, 2017; Chickering & Gamson, 1987; Gonda et al., 2018). In addition, active learning activities facilitate students 'learning and are crucial for developing teachers' teaching skills. Because in the active learning process, the teacher participates in all teaching stages with the students (Taylor et al., 2020).

Feedback is one of the most important factors for learning in education. Feedback, one of the essential variables that the teacher should focus on in the lesson process, allows the students to ask about the parts they do not understand in the lesson and whether their answers are correct or incorrect. When students see their mistakes, they correct them, and if there is a deficiency, they complete it (Beydoğan, 2018; Chickering & Ehrmann, 1996; Duijnhouwer et al., 2012; Şimşek et al., 2012; Voerman et al., 2012). Also, feedback increases communication between students and teachers. A teacher who gives effective feedback gains the students' trust and gives students the feeling that their answers are important. In this way, students see that they are essential in the eyes of the teacher. Thus, teacher-student communication is strengthened, and students participate more in the lesson thanks to effective feedback (Dahalan et al., 2013; Tanis, 2021). Another critical point to be considered while giving feedback is that feedback should be designed in such a way that it is given effectively and in the shortest time. Given feedback to students should be conveyed in a written, verbal, or virtual environment depending on the situation of the subject (Besser & Newby, 2020; Chickering & Ehrmann, 1996; Getzlaf et al., 2009; Gielen et al., 2010; Okumuş & Doymuş, 2020). Rowe and Wood (2008) stated that the most effective feedback is student performance-based feedback that informs students about why they do not understand and what they should do to learn about a topic they do not understand and leads students to think about what they do.

The fifth principle of the SPGP includes the "time on tasks." The student who fulfills his/her task on time learns to work more disciplined, to take responsibility, and to fulfill this responsibility (Al-Furaih, 2017; Chickering & Gamson, 1987; Graham et al., 2001; Okumuş & Doymuş, 2020). Students need help for effective time management in learning (Chickering & Gamson, 1987). In this respect, it is not enough for students to fulfill their tasks on time. Here, the students must do the homework that the teacher gives them on time, and the teacher must check it on time, which is especially important. The teacher checks the tasks (s)he gives on time and gives them confidence that their efforts will not be unrequited. In this way, the sense of trust between teacher and

student is reinforced. In addition, a teacher checks the task given to the students promptly, which contributes to revealing the students' deficiencies or determining if there are any points they know wrongly about the subject. In this respect, it is essential to fulfill the duties on time to provide good practice and strengthen the feelings of mutual responsibility (Bishoff, 2010; Okumuş, 2017; Okumuş & Doymuş, 2020).

Every student goes to school with certain expectations. Some students have high expectations for the profession and business life, while others aim only to finish school. Johnson (2014) emphasizes that every student goes to school with a small or large expectation. In this context, guiding teachers is important (Tanis, 2020). Directing each student to a suitable school or profession according to their abilities, interests, and abilities will increase the quality of education. At this point, teachers know their students well, and guiding them toward achievable goals is essential (Alyar & Doymuş, 2020; Chickering & Gamson, 1987; Şimşek et al., 2012).

Each student is a different world and has different characteristics: learning styles and styles are different. Some students learn by writing, some by reading, others by seeing, and some by touching. Students' abilities to learn information also differ due to these differences (Chickering & Gamson, 1987; Demirel, 2010; Legg et al., 2020; Okumuş, 2017). For this, diversifying the learning environment and employing different teaching methods and techniques in the course process are necessary. In this context, there are many different teaching approaches, models, methods, and techniques, such as cooperative learning, REACT, argumentation, problem-based learning, STEM, model-based learning, inquiry-based learning, and computer-assisted learning, which are suitable for constructivist learning theory and active add students to the process. When considered in terms of the content of the science course, these approaches/models/methods/ are suitable for these applications. In this context, science teachers diversify the teaching process to actively include students with different learning styles in the course process, as stated in the literature (Al-Furaih, 2017; Martin & Bolliger, 2018; Tanis, 2020).

Good practices performed in the educational process increase the cognitive and affective development of students, ensure the permanence of learning, and help students in their career goals (Culver et al., 2021; Jessup-Anger, 2012; Loes et al., 2014; Padgett, 2011; Pascarella et al., 2011). Accordingly, the importance of the SPGP increases in the education process. Considering the studies conducted on the SPGP in the literature, most of the work focused on determining the situation (Aydoğdu, 2012; Bishoff, 2010; Frederickson, 2015; Hathaway, 2014; Jabar & Albion, 2016; Musaitif, 2013; Tirrell, 2009), applied studies are pretty limited (Alyar, 2018; Çavdar, 2016; Okumuş, 2017; Öztürk, 2017; Pascarella et al., 2006), and there are generally studies on the SPGP in online and distance education (Al-Furaih, 2017; Crews et al., 2015; Hathaway, 2014; Kocaman Karaoğlu et al., 2014; Tanis, 2020). There is no study in which science teachers practice in detail. This study reveals to what extent science teachers know and apply the SPGP and their opinions about the more effective implementation of the SPGP. The questions for which answers are sought within the framework of this purpose are as follows:

1. What is science teachers' knowledge of the SPGP?
2. What are the applications of science teachers regarding the SPGP?
3. What are the science teachers' suggestions about using the SPGP effectively?

METHOD

Methodology

A case study was used in this research. A case study is used when one or more events or situations are intended to be examined in detail (McMillan & Schumacher, 2010). It is used to identify and describe the details that make up an event, provide explanations about an event, and evaluate an event (Gall et al., 2007). In this research, the case study design was chosen because the views and practices of science teachers about the SPGP were wanted to be determined in detail.

Participants

The sample consists of 73 science teachers from different regions of Türkiye, serving in 23 cities (Adana, Ağrı, Amasya, Ankara, Bingöl, Bursa, Erzincan, Erzurum, Eskişehir, Gaziantep, Iğdır, İstanbul, İzmit, Kahramanmaraş, Kayseri, Mersin, Muğla, Muş, Rize, Şırnak, Tekirdağ, Van and Zonguldak). 43 (58.9%) of the science teachers participating in the study are women and 30 (41.1%) are men. Convenience sampling methods and science teachers collected the data from all geographical regions Türkiye has tried to reach. Convenience sampling is used when sampling is easy to access and requires time and labor convenience (McMillan & Schumacher, 2010). There are seven geographic regions in Türkiye. The data obtained from the science teachers who participated in this study were evaluated under "east" and "west" regions, not separately in seven geographical regions. Turkey's western part (Marmara, Aegean, Western Black Sea Region, Mediterranean Region, and the Western part of Central Anatolia) is more advanced and economically, creating the part of the more affluent, eastern part (Eastern Black Sea Region, the Eastern Part of Central, Eastern and Southeastern Anatolia) is more includes underdeveloped cities. Ministry of Education, teacher assignments mostly take place in less developed cities of Türkiye's eastern (especially in Eastern and Southeastern Anatolia), which gives priority to Türkiye. Therefore, most science teachers who are new to the profession work in the eastern part of the country. Table 1 shows the distribution of the teachers participating in the study according to experience, the type of school, and gender.

Table 1. Science teachers participating in the study (gender, experience/seniortiy, the type of school served)

Gender	Region	Experience/Seniority (f)				Total
		1-5 years	6-10 years	11-15 years	16-20 years	
Women	East	22 (16SS, 6PS)	1PS	2SS	1SS	26
	West	13SS	2SS	1SS		17
Men	East	14 (8SS, 6PS)	6 (5SS, 1PS)	2SS	1SS	23
	West	3 (2SS, 1PS)	4 (3SS, 1PS)			7
Total		52	13	5	3	73

SS: State school, PS: Private school

According to Table 1, while 49 (26 women, 23 men) science teachers work in eastern cities, 24 (17 women, seven men) work in western cities. In addition, most of the science teachers who participated in the study were novices (1-5 years).

All ethical rules were followed, and the teachers' identities were kept confidential in this study. The teachers' names were not disclosed; each science teacher was coded ST1, ST2, or ST3… In this way, privacy was tried to be provided. Teachers voluntarily participated in this study; they were fully informed, and their consent was obtained before the study.

Data Collection

A questionnaire (Questionnaire of Seven Principles-QSP) consisting of 8 open-ended questions was used to collect data. Although the questionnaires generally contain closed-ended and short questions, open-ended questions are also used because they allow more detailed information to be obtained and can be used with smaller samples (McMillan & Schumacher, 2010). In addition, open-ended questionnaires should be used when individuals' answers regarding the research subject are essential and more appropriate (McMillan & Schumacher, 2010). For the research, the questionnaire was arranged to be open-ended. The questions were prepared to include all the SPGP created by Chickering and Gamson (1987). In the first question, teachers were asked what the SPGP was, and in the other questions, the practices and suggestions of the teachers for each principal were taken. Accordingly, the first question in the QSP consists of one; the other questions consist of two open-ended questions. After the questions were created, the QSP was reviewed by two science education experts. According to expert opinions, formal and semantic arrangements were made in the questionnaire. Later, the QSP was piloted with two science teachers. At the end of the pilot application, necessary corrections were made to the incomprehensible parts of the questions, and the survey was finalized. The QSP was applied directly to science teachers and on the internet. The questionnaire was directly applied to the teachers in the city where the researcher lived. The direct data collection process applied the QSP to science teachers face-to-face. To collect data online, the researcher sent the QSP to the participants via e-mail and a social media application and received feedback. The data in the study were collected on an entirely voluntary basis. Science teachers' identities would not be divulged, and they were asked to answer the questions honestly. The teachers were not asked for their names; only their city of residence, gender, state or private school, work, and experience (seniority) were taken.

Data Analyses

Descriptive statistics were made to the QSP data for the analysis, and the frequency and percentage values were examined. In addition, the answers given to the QSP by the science teachers participating in the study were analyzed according to gender, experience (seniority), and geographical region categories.

Content analysis is the systematic summarization of parts of a text in smaller and fewer words (Büyüköztürk et al., 2012). Separate themes and codes were created for each question when conducting the content analysis in this study. The codes created by the researcher were then re-coded by an expert. The percentage of agreement between the researcher and the expert was calculated by Miles and Huberman's (1994) formula [Reliability = consistency / (consistency + disagreement) x 100]. Consistency percentage was calculated as 98.3%. The themes and codes used in data analysis differ for each question. Therefore, the themes and codes were given in the findings section.

FINDINGS

Findings Related to the First Question of the QSP

The first question in the QSP aims to reveal science teachers' general knowledge of the SPGP. The science teachers' answers to the question were grouped under six themes. Table 2 shows the science teachers' answers to the first question.

Table 2. Findings regarding the first question in the QSP

Explain	Gender				Type of school				Experience (Seniority)								Region			
	Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Correct	5	11.6	2	6.7	5	8.8	2	12.5	5	9.6	2	15.4	-	-	-	-	5	10.2	2	8.3
Partially correct	15	34.8	12	40	22	38.6	5	31.3	18	34.6	6	46.2	2	40	1	50	16	32.7	9	37.5
I have no information. However, I think...	2	4.7	3	10	4	7	1	6.3	5	9.6	-	-	-	-	-	-	3	6.1	2	8.3
I have no information.	12	27.9	10	33.3	17	29.8	5	31.3	14	26.9	5	33.3	3	60	-	-	13	26.5	9	37.5
False	4	9.3	2	6.7	3	5.3	3	18.8	6	11.5	-	-	-	-	-	-	5	10.2	1	4.2
Empty	5	11.6	1	3.3	6	10.5	-	-	5	9.6	-	-	-	-	1	50	6	12.2	-	-

SS: State school, PS: Private school, E: East, W: West

According to Table 2, most science teachers participating in the study needed more information about the SPGP. Some sample expressions from science teachers' knowledge and opinions about the SPGP are given.

> *"One of the SPGP can be student-school, student-teacher interaction. The better the students adapt to the school, the higher the efficiency of education. The frequency of the relationship between the student and the teacher in the school affects the motivation of the student's interest in school. At the same time, the method and technique used in teaching can be one of these SPGP." ST4 (partially correct)*

> *"I do not have detailed information on this subject. However, I think it covers the following questions I have been asked." ST24 (I have no information. But I think…)*

Based on the examples above, some science teachers are aware of their contents even if they do not know the SPGP by name can be inferred.

Findings Related to the Second Question of the QSP

The second question in the QSP concerns student-school communication, which is the first principle of the SPGP. This question consists of two parts. In the first part, science teachers were asked what they did to increase student-school interaction, and in the second part, teachers' suggestions were taken on this issue. The first part of the question has been analyzed using three themes and 12 codes. Table 3 shows the science teachers' answers regarding the first part of the second question.

Table 3. Findings about the first part of the second question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Out-of-class Activities	Social	13	30.2	6	20	19	33.3	1	6.3	12	23.1	5	38.5	2	40	1	50	14	28.8	3	12.5
	Scientific/ related to subject	3	7	2	6.7	4	7	1	6.3	3	5.8	2	15.4	-	-	-	-	3	6.1	2	8.3
	Positive school environment	5	11.6	5	16.7	6	10.5	4	25	9	17.3	1	7.7	-	-	-	-	8	16.3	2	8.3
Communication	Students	10	23.3	3	10	10	17.5	3	18.8	11	21.2	2	15.4	-	-	-	-	7	14.3	6	25
	Parents	6	14	3	10	7	12.3	2	12.5	5	9.6	2	15.4	2	40	-	-	5	10.2	4	16.7
	School Management	1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
	Guidance service	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
In-class Activities	Different methods, techniques	12	27.9	8	26.7	18	31.6	2	12.5	15	28.8	5	38.5	-	-	-	-	14	28.8	6	25
	Duty/ responsibility	3	7	3	10	4	7	2	12.5	3	5.8	2	15.4	-	-	1	50	4	8.2	2	8.3
	Positive classroom environment	6	14	5	16.7	10	17.5	1	6.3	8	15.4	1	7.7	1	20	1	50	7	14.3	4	16.7

Themes and codes*		Gender				Type of School				Experience (Seniority)										Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20				E		W		
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%			f	%	f	%
	Relative to the student	2	4.7	3	10	5	8.8	-	-	2	3.8	1	7.7	2	40	-	-			2	4.1	3	12.5
	Active participation	3	7	3	10	3	5.3	3	18.8	6	11.5	-	-	-	-	-	-			4	8.2	2	8.3
I didn't make an effort		1	2.3	1	3.3	-	-	2	12.5	1	1.9	1	7.7	-	-	-	-			2	4.1	-	-
Empty		-	-	1	3.3	1	1.8	-	-	1	1.9	-	-	-	-	-	-			1	2	-	-

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 3, science teachers prioritize in-class and out-of-class activities to ensure student-school interaction. They tend to apply different methods and techniques for in-class activities and prioritize social activities for out-of-class activities. In addition, they try to communicate with students, parents, school administration, and guidance services to ensure student-school interaction. Sample responses of science teachers' practices regarding student-school interaction are given.

"I try to spend more time with the students. We attach importance to extracurricular activities. As extracurricular activities, we include music, painting, physical education, etc., only activities that students can do together in the school." ST40 (Out-of-class Activities- social)

"As a science teacher, I endeavor to teach the lessons in a fun way to both endear my class and encourage them to come to school." ST56 (Out-of-class Activities- Positive school environment)

"I try to chat with them outside of class and make them feel valued and love the school." ST5 (Communication- students)

"I try to process my lessons with activities and experiments as much as possible. I take advantage of all the possibilities to concretize the lesson." ST33 (In-class Activities- Different methods, techniques)

"There is a wide variety of studies. Some: By including students in board meetings, we receive their ideas, opinions, and suggestions. It also uses a 'wish box'. Every Friday, the principal examines the requests in the wish box and shares the suggestions and complaints with the school's stakeholders at the flag ceremony. Social media group information sharing (Facebook), school clubs, school family association meetings, and student-teacher sports activities (table tennis, chess, football matches) are held. One-to-one and group follow-ups are carried out with the student coaching system. Parent home visits and one-to-one meetings with appointments are held." ST18 (Out-of-class Activities- Scientific/ related to subject, Communication-Parents and School Management, In-class Activities- Duty/responsibility)

According to the examples, science teachers practice different practices inside and outside the school to ensure student-school interaction.

The second part of the question was analyzed using four themes and 17 codes. Table 4 shows the answers of the science teachers regarding the second part of the second question.

Table 4. Findings about the second part of the second question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Out-of-class Activities	Social	6	14	4	13.3	8	14	2	12.5	8	15.4	2	15.4	-	-	-	-	9	18.4	1	4.2
	Course load	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Positive school environment	1	2.3	2	6.7	2	3.5	1	6.3	3	5.8	-	-	-	-	-	-	1	2	2	8.3
	Physical facilities	2	4.7	1	3.3	3	5.3	-	-	1	1.9	1	7.7	1	20	-	-	2	4.1	1	4.2
Communication	Student	10	23.2	7	23.3	13	22.8	4	25	13	25	4	30.8	-	-	-	-	12	24.5	5	20.8
	Parent	5	11.6	1	3.3	5	8.8	1	6.3	5	9.6	1	7.7	-	-	-	-	5	10.2	1	4.2
	School Management	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Desire towards school/ lesson	3	7	3	10	5	8.8	1	6.3	5	9.6	-	-	1	20	-	-	4	8.2	2	8.3

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
	Trust	4	9.3	4	13.3	6	10.5	2	12.5	7	13.5	1	7.7	-	-	-	-	6	12.2	2	8.3
	Values education	1	2.3	1	3.3	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
In-class Activities	Different methods, techniques	5	11.6	1	3.3	6	10.5	-	-	4	7.7	1	7.7	-	-	1	50	2	4.1	4	16.7
	Duty/ responsibility	3	7	1	3.3	3	5.3	1	6.3	3	5.8	1	7.7	-	-	-	-	1	2	3	12.5
	Positive classroom environment	3	7	3	10	4	7	2	12.5	4	7.7	1	7.7	1	20	-	-	5	10.2	1	4.2
	Relative to the student	2	4.7	1	3.3	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
	Activities	8	18.6	5	16.7	10	17.5	3	18.8	9	17.3	-	-	2	40	2	100	8	16.3	5	20.8
	Active participation	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	1	2	1	4.2
Job	Teacher	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
Empty		4	9.3	4	13.3	6	10.5	2	12.5	5	9.6	1	7.7	2	40	-	-	6	12.2	2	8.3

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 4, they mainly made suggestions for communication and classroom activities to increase student-school interaction. In addition, some science teachers stated that student-school interaction would be increased with out-of-class activities. Some crucial suggestions of science teachers to increase student-school interaction are given.

"The needs of the children must be met. I think the biggest task here falls to the school administration. This unit manages the training needs and staffing required." ST70 (Out-of-class Activities- Physical facilities)

"Environments where the student can feel comfortable should be prepared." ST34 (Communication- Trust)

"Remarkable, up-to-date project assignments can be presented to the class, and a process can be planned per the student's request. For students to participate in the lesson more, current news on the subject can be brought to the classroom environment, and a discussion environment can be provided. Students can thus exchange ideas with each other. In addition, if there are areas of application in life-related to the subject covered in the course, a short explanation can be given to the student. If the student is informed about why he/she learns and where in his/her life he/she learns, his/her attitude towards the lesson will change. Having a positive attitude towards the lesson will increase school-student interaction." ST16 (In-class Activities- Different methods, techniques, Duty/ responsibility, and Positive classroom environment)

Considering the suggestions of science teachers to increase student-school interaction in the examples given, to increase interaction within and outside the school, improve communication, and create a positive classroom environment were emphasized.

Findings Related to the Third Question of the QSP

The third question in QSP is related to cooperation between students. This question consists of two parts. In the first part, science teachers were asked what they did to increase student-student interaction, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed using two themes and nine codes. Table 5 shows the answers of the science teachers regarding the first part of the third question.

Table 5. Findings about the first part of the third question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
In-class Activities	Group work	18	41.9	19	63.3	29	50.9	8	50	23	44.2	9	69.2	3	60	2	100	26	53.1	11	45.8
	Group assignment	12	27.9	3	10	11	19.3	4	25	14	26.9	1	7.7	-	-	-	-	10	20.4	5	20.8
	Cooperative learning	3	7	3	10	4	7	2	12.5	4	7.7	2	15.4	-	-	-	-	4	8.2	2	8.3

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
	Different methods, techniques	14	32.6	8	26.7	16	28.1	6	37.5	16	30.8	3	23.1	3	60	-	-	13	26.5	9	37.5
	Interaction	3	7	4	13.3	6	10.5	1	6.3	4	7.7	3	23.1	-	-	-	-	5	10.2	2	8.3
Out-of-class Activities	Project	4	9.3	4	13.3	6	10.5	2	12.5	6	11.5	2	15.4	-	-	-	-	7	14.3	1	4.2
	Research	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1		
	Quiz program	-	-	1	3.3	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2		
	Social activities	2	4.7	3	10	4	7	1	6.3	4	7.7	1	7.7	-	-	-	-	3	6.1	2	8.3
Empty		1	2.3	1	3.3	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1		

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 5, the majority of science teachers stated that they prefer classroom activities to increase student cooperation. At this point, science teachers especially value group work. Sample responses of science teachers' practices regarding cooperation between students are given.

 "I do group work." ST71 (In-class Activities- Group work)

"I assign homework, solve tests in groups, and try to increase their cooperation by assigning project assignments." ST29 (In-class Activities- Group assignment and Different methods, techniques; Out-of-class Activities- Project)

"We spend time with our students not only in the school environment but also in environments that allow them to socialize with their environment (cinema, bowling, taboo, ..." ST35 (Out-of-class Activities- Social activities)

According to the examples, science teachers emphasize in-class and out-of-class student communication.

The second part of the question was analyzed using two themes and nine codes. Table 6 shows the science teachers' answers to this part of the third question.

Table 6. Findings about the second part of the third question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
In-class Activities	Group work	12	27.9	9	30	15	26.3	6	37.5	15	28.8	4	30.8	1	20	1	50	15	30.6	6	25
	Group assignment	6	14	3	10	3	5.3	6	37.5	8	15.4	1	7.7	-	-	-	-	8	16.3	1	4.2
	Cooperative learning	3	7	5	16.7	7	12.3	1	6.3	4	7.7	4	30.8	-	-	-	-	6	12.2	2	8.3
	Different methods, techniques	7	16.3	5	16.7	11	19.3	1	6.3	9	17.3	2	15.4	-	-	-	-	8	16.3	4	16.7
	Responsibility	4	9.3	2	6.7	4	7	2	12.5	4	7.7	1	7.7	-	-	1	50	4	8.2	2	8.3
	Interaction	12	27.9	8	26.7	15	26.3	5	31.3	13	25.0	6	46.2	1	20	-	-	16	32.7	4	16.7
Out-of-class Activities	Project	4	9.3	2	6.7	4	7	2	12.5	5	9.6	1	7.7	-	-	-	-	4	8.2	2	8.3
	Research	-	-	1	3.3	1	1.8	-	-	-	-	-	-	1	20	-	-	1	2	-	-
	Social activities	2	4.7	2	6.7	3	5.3	1	6.3	4	7.7	-	-	-	-	-	-	3	6.1	1	4.2
Empty		7	16.3	5	16.7	11	19.3	1	6.3	9	17.3	1	7.7	2	40	-	-	7	14.3	5	20.8

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 6, science teachers had the most suggestions about classroom activities, especially group work and communication, to increase student cooperation. Some crucial suggestions of science teachers for increasing cooperation between students are given.

"Students should be given not only individual responsibilities but also responsibilities to keep them organized and cooperative in group work." ST9 (In-class Activities- Responsibility)

"It is necessary to instill the belief that "unity is strength." They should observe that different ideas produce good work." ST12 (In-class Activities- Interaction)

"My recommendations are to increase out-of-school student interaction, increase cluster and group work, and adopt a cooperative learning model." ST45 (In-class Activities-Group work, Cooperative learning; Out-of-class Activities- Social activities)

According to the examples, science teachers value responsibility and interaction to ensure student cooperation and suggest cooperative learning.

Findings Related to the Fourth Question of the QSP

The fourth question in the QSP concerns the provision of active learning, which is the third principle of the SPGP. In the first part, science teachers were asked what they did to increase active learning, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed using four themes and ten codes. Table 7 shows the answers of the science teachers regarding the first part of the fourth question.

Table 7. Findings about the first part of the fourth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different methods, techniques	Different methods	3	7	1	3.3	4	7	-	-	3	5.8	1	7.7	-	-	-	-	3	6.1	1	4.2
	Different techniques	21	48.8	18	60	31	54.4	8	50	32	61.5	6	46.2	-	-	1	50	25	51	14	58.3
	Technology	2	4.7	1	3.3	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
	Research/ Project	5	11.6	5	16.7	7	12.3	3	18.8	8	15.4	1	7.7	1	20	-	-	8	16.3	2	8.3
Communication	Responsibility	3	7	1	3.3	4	7	-	-	1	1.9	-	-	2	40	1	50	4	8.2	-	-
	Orientation	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
Learning by doing and experiencing	Active participant	12	27.9	7	23.3	15	26.3	4	25	14	26.9	4	30.8	1	20	-	-	12	24.5	7	29.2
	Take attention	6	14	5	16.7	8	14	3	18.8	6	11.5	4	30.8	1	20	-	-	6	12.2	5	20.8
	Creating environment	10	23.2	5	16.7	11	19.3	4	25	11	21.2	2	15.4	1	20	1	50	9	18.4	6	25
	Associating daily life	2	4.7	1	3.3	2	3.5	1	6.3	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
I am not doing anything		1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to the answers given in Table 7, science teachers mostly turned to different methods and techniques to ensure active learning, and they tried to learn by doing and experiencing. Sample responses of science teachers' practices regarding providing active learning are given.

"Active learning is not possible for all subjects. However, I aim to reach information by combining parts like questions and answers, brainstorming, and induction. Since safety is at the forefront in laboratory activities, although I generally do it as a demonstration experiment, I include them in the work when necessary." ST7 (Different methods, techniques- Different techniques)

"I would like my students to do research. I want them to present their research in the classroom. I want them to work independently, and I want their work to relate to daily life." ST37 (Different methods, techniques- Research/ Project)

"I make the students participate in the lesson by giving them more responsibility. I also apply question and answer, brainstorming, and six hat techniques." ST39 (Different methods, techniques- Different techniques, responsibility)

"I put students at the center of the topic." ST28 (Learning by doing and experiencing- Active participant)

"To realize active learning, I am preparing an environment for students to participate in the class" ST15 (Learning by doing and experiencing- Creating environment)

According to the examples, science teachers apply different learning methods and techniques to ensure active learning and care about students' responsibilities and participation.

The second part of the question was analyzed using four themes and 19 codes. Table 8 shows the science teachers' answers to this part of the fourth question.

Table 8. Findings about the second part of the fourth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different methods, techniques	Different methods	4	9.3	1	3.3	4	7	1	6.3	4	7.7	1	7.7	-	-	-	-	4	8.2	1	4.2
	Different techniques	6	14	4	13.3	9	15.8	1	6.3	7	13.5	2	15.4	-	-	1	50	6	12.2	4	16.7
	Technology	1	2.3	3	10	3	5.3	1	6.3	4	7.7	-	-	-	-	-	-	4	8.2	-	-
	Thinking skills	1	2.3	-	-	1	1.8	-	-	-	-	1	7.7	-	-	-	-	-	-	1	4.2
	Research/ Project	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	1	2	1	4.2
Communication	Responsibility	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Orientation	1	2.3	4	13.3	3	5.3	2	12.5	1	1.9	4	30.8	-	-	-	-	3	6.1	2	8.3
	Interest, desire	-	-	2	6.7	1	1.8	1	6.3	1	1.9	-	-	-	-	1	50	2	4.1	-	-
	Interaction	-	-	1	3.3	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Self-expression	1	2.3	1	3.3	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	1	2	1	4.2
	Practitioners	1	2.3	1	3.3	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
Learning by doing and experiencing	Active participant	13	30.2	5	16.7	14	24.6	4	25	14	26.9	3	23.1	1	20	-	-	14	28.6	4	16.7
	Take attention	1	2.3	3	10	3	5.3	1	6.3	4	7.7	-	-	-	-	-	-	2	4.1	2	8.3
	Creating environment	2	4.7	1	3.3	2	3.5	1	6.3	2	3.8	1	7.7	-	-	-	-	3	6.1	-	-
	Individual differences	6	14	-	-	5	8.8	1	6.3	6	11.5	-	-	-	-	-	-	4	8.2	2	8.3
	Associating daily life	2	4.7	3	10	1	1.8	4	25	5	9.6	-	-	-	-	-	-	5	10.2	-	-
Extracurricular situations	Physical facilities	2	4.7	2	6.7	3	5.3	1	6.3	3	5.8	1	7.7	-	-	-	-	2	4.1	2	8.3
	Opportunity Equality	2	4.7	1	3.3	2	3.5	1	6.3	2	3.8	-	-	1	20	-	-	2	4.1	1	4.2
	Curriculum	1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	-	-	2	8.3
Empty		7	16.3	5	16.7	11	19.3	1	6.3	9	17.3	-	-	3	60	-	-	8	16.3	4	16.7

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 8, they mostly touched on learning by doing for active learning. Also, teachers drew attention to communication issues with different methods and techniques. Some crucial suggestions for science teachers to increase active learning are given.

"There should be student assignments and activities that more students can do. Teaching should be done through project-based teaching or invention." ST17 (Different methods, techniques- Different methods)

"The most important learning for the science lesson is the one in which the laboratory is used, and the students take an active role. First, a laboratory environment must be created at the secondary school level. However, educational technologies should be supported and used as much as possible." ST40 (Different methods, techniques- Different techniques and technology)

"For students to express themselves, it is necessary to guide them and direct various scientific studies by respecting their ideas." ST8 (Different methods, techniques- Different techniques; Communication- Orientation and Self-expression; Learning by doing and experiencing- Associating daily life)

"My advice is to pay maximum attention to individual differences." ST3 (Learning by doing and experiencing- Individual differences)

"Every school should have a well-equipped library and technological equipment" ST-66 (Extracurricular situations- Physical facilities)

According to the examples, science teachers recommend using different teaching methods and techniques to ensure active learning, increase student interaction, associate the subjects with daily life, and improve the school's physical facilities.

Findings Related to the Fifth Question of the QSP

The fifth question in the QSP concerns prompt feedback, the fourth principle of the SPGP. In the first part, science teachers were asked what they did to give prompt feedback, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed using four themes and 18 codes. Table 9 shows the answers of the science teachers regarding the first part of the fifth question.

Table 9. Findings about the first part of the fifth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different applications	Techniques	3	7	-	-	3	5.3	-	-	2	3.8	-	-	1	20	-	-	3	6.1	-	-
	Technology	-	-	1	3.3	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2	-	-
	Research/ Project/ Homework	1	2.3	2	6.7	1	1.8	2	12.5	3	5.8	-	-	-	-	-	-	3	6.1	-	-
Feedback	Show errors	8	18.6	3	10	9	15.8	2	12.5	8	15.4	3	23.1	-	-	-	-	6	12.2	5	20.8
	Understanding the wrong	7	16.3	4	13.3	11	19.3	-	-	8	15.4	1	7.7	2	40	-	-	6	12.2	5	20.8
	Correct the wrong	8	18.6	3	10	8	14	3	18.8	8	15.4	2	15.4	1	20	-	-	8	16.3	3	12.5
	Find the right	8	18.6	2	6.7	8	14	2	12.5	8	15.4	1	7.7	1	20	-	-	6	12.2	4	16.7
	Emphasis	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Attractive	-	-	1	3.3	1	1.8	-	-	-	-	-	-	-	-	1	50	1	2	-	-
	Prompt	4	9.3	2	6.7	4	7	2	12.5	4	7.7	2	15.4	-	-	-	-	3	6.1	3	12.5
Clue/ Reinforcement	Clue	8	18.6	2	6.7	9	15.8	1	6.3	9	17.3	1	7.7	-	-	-	-	8	16.3	2	8.3
	Prize	11	25.6	5	16.7	12	21.1	4	25	11	21.2	4	30.8	1	20	-	-	13	26.5	3	12.5
Asking question	Whole process	12	27.9	10	33.3	18	31.6	4	25	14	26.9	5	38.5	3	60	-	-	16	32.7	6	25
	At the beginning of the course	1	2.3	2	6.7	2	3.5	1	6.3	3	5.8	-	-	-	-	-	-	3	6.1	-	-
	During the course	4	9.3	3	10	5	8.8	2	12.5	5	9.6	1	7.7	1	20	-	-	6	12.2	1	4.2
	At the end of the course	1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
Test/ quiz	During the course	4	9.3	3	10	5	8.8	2	12.5	5	9.6	1	7.7	1	20	-	-	6	12.2	1	4.2
	At the end of the course	6	14	2	6.7	7	12.3	1	6.3	5	9.6	2	15.4	-	-	1	50	4	8.2	4	16.7
Empty		4	9.3	1	3.3	3	5.3	2	12.5	5	9.6	-	-	-	-	-	-	3	6.1	2	8.3

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 9, science teachers pay attention to the process of giving feedback about the fourth principle and ask questions in various parts of the course throughout the process. In addition, the teachers used claims and prizes to give feedback. Sample responses of science teachers' practices regarding giving prompt feedback are given.

 "I answer the questions according to the readiness of the student. For example, I can get a drama work done right away." ST57 (Different applications- Techniques)

"I first try to make sure that the mistake made is understood and remedied by the student by giving hints. I look at "what he/she has to understand," "what he/she has to understand, " ST22 (Feedback- Show errors and Understanding the wrong)

"I use the question-and-answer method. I give awards to honor students." ST19 (Clue/ Reinforcement- Prize)

"I check what they know before starting my lesson. During the lecture, "What have we learned? "What was this?" "Who remembers this?" I ask questions in the style of." ST13 (Asking question- Whole process, At the beginning of the course and During the course)

"I do small quizzes at the end of the topic. These questions are sometimes open-ended and sometimes multiple-choice. We check the answers together with the students to see the mistakes made. Seeing the correct answers, they become aware of their mistakes." ST4 (Feedback- Show errors; Test/ quiz- At the end of the course)

According to the examples, science teachers use different practices to fulfill the instant feedback principle. They show students their mistakes, give clues, ask questions in the teaching process, and conduct tests and quizzes to determine whether the subjects are understood.

The second part of the question was analyzed using six themes and 17 codes. The science teachers' answers regarding the second part of the fifth question are given in Table 10.

Table 10. Findings about the second part of the fifth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different applications		4	9.3	3	10	4	7	3	18.8	4	7.7	3	23.1	-	-	-	-	5	10.2	2	8.3
Feedback	Show errors	3	7	2	6.7	3	5.3	2	12.5	4	7.7	-	-	1	20	-	-	3	6.1	2	8.3
	Understanding the wrong	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	1	2	1	4.2
	Correct the wrong	1	2.3	1	3.3	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	Find the right	1	2.3	2	6.7	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	3	6.1	-	-
	During the course	4	9.3	1	3.3	4	7	1	6.3	5	9.6	-	-	-	-	-	-	3	6.1	2	8.3
	Language	8	18.6	4	13.3	8	14	4	25	11	21.2	1	7.7	-	-	-	-	10	20.4	2	8.3
	Prompt	2	4.7	6	20	8	14	-	-	4	7.7	4	30.8	-	-	-	-	4	8.2	4	16.7
Clue/ Reinforcement	Clue	1	2.3	1	3.3	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	Prize	5	11.6	4	13.3	8	14	1	6.3	5	9.6	3	23.1	-	-	1	50	7	14.3	2	8.3
Asking question	Whole process	1	2.3	1	3.3	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
	During the course	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	At the end of the course	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
Test/ quiz	At the beginning of the course	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	At the end of the course	3	7	1	3.3	3	5.3	1	6.3	2	3.8	2	15.4	-	-	-	-	2	4.1	2	8.3
Communication	Recognition	-	-	1	3.3	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2	-	-
	Interaction	5	11.6	4	13.3	7	12.3	2	12.5	7	13.5	1	7.7	1	20	-	-	6	12.2	3	12.5
	To the students	-	-	1	3.3	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2	-	-
Empty		12	27.9	8	26.7	16	28.1	4	25	15	28.8	1	7.7	3	60	1	50	12	24.5	8	33.3

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 10, the teachers offered the most suggestions for the feedback processes to give prompt feedback. In addition, suggestions for giving clues/reinforcements, communicating with students, and applying different methods were also determined. Some critical suggestions from science teachers for prompt feedback are given.

"Using the question-answer technique more widely" ST31 (Different applications)

"When giving feedback, it should be given in a softer voice and more understandable way so that the student finds his / her mistake and permanent learning takes place." ST5 (Feedback- Language)

"I think giving the prompt feedback will prevent misperception." ST7 (Feedback- Prompt)

"If the correct answer is given, it should be rewarded with reinforcements, and if the wrong answer is given, the student should be aware of this instead of telling the student that the answer is wrong." ST17 (Feedback - Understanding the wrong; Clue/ Reinforcement- Prize)

"Let the students ask lots of questions so that their wonderful minds work harder." ST56 (Asking the question- During the course)

"We can get feedback on what we have learned at the end of each lesson with the question and answer method, or, as I said before, we can make short scans on the subject." ST11 (Asking the question- At the end of the course; Test/ quiz- At the end of the course)

"It is necessary not to lose eye contact with the student and to focus on the subject by asking questions to distract the instant distraction." ST25 (Feedback- Prompt; Communication- Interaction)

According to the examples, science teachers offer suggestions for effectively using the instant feedback principle, including giving feedback on time, showing students their mistakes, giving clues to find mistakes, interacting with students, and asking questions at the end of the lesson.

Findings Related to the Sixth Question of the QSP

The sixth question in the QSP concerns time on task, which is the fifth principle of the SPGP. In the first part, science teachers were asked what they did to complete time on task, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed using three themes and 19 codes. Table 11 shows the answers of the science teachers regarding the first part of the sixth question.

Table 11. Findings about the first part of the sixth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Reinforcement	Prize	21	48.8	8	26.7	26	45.6	3	18.8	21	40.4	4	30.8	3	60	1	50	20	40.8	9	37.5
	Reinforcement	5	11.6	2	6.7	6	10.5	1	6.3	6	11.5	-	-	-	-	1	50	4	8.2	3	12.5
	Punishment	6	14	3	10	7	12.3	2	12.5	7	13.5	2	15.4	-	-	-	-	6	12.2	3	12.5
Task	Tell time	5	11.6	1	3.3	6	10.5	-	-	4	7.7	1	7.7	1	20	-	-	2	4.1	4	16.7
	Complete on time	-	-	2	6.7	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
	Check in time	5	11.6	5	16.7	9	15.8	1	6.3	5	9.6	4	30.8	1	20	-	-	4	8.2	6	25
	Responsibility (student)	7	16.3	3	10	8	14	2	12.5	9	17.3	-	-	-	-	1	50	8	16.3	2	8.3
	Responsibility (teacher)	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Working schedule	3	7	5	16.7	5	8.8	3	18.8	5	9.6	3	23.1	-	-	-	-	5	10.2	3	12.5
	Criterion	-	-	2	6.7	2	3.5	-	-	-	-	1	7.7	1	20	-	-	2	4.1	-	-
	Results	6	14	4	13.3	8	14	2	12.5	9	17.3	-	-	1	20	-	-	6	12.2	4	16.7
	Flexible time	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Reminding	-	-	3	10	3	5.3	-	-	1	1.9	2	15.4	-	-	-	-	3	6.1	-	-
	Importance of time	-	-	1	3.3	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2	-	-
	Note	4	9.3	-	-	4	7	-	-	3	5.8	-	-	-	-	1	50	4	8.2	-	-
	To assign a task to those who want	-	-	1	3.3	1	1.8	-	-	-	-	1	7.7	-	-	-	-	1	2	-	-
Communication	Motivation	3	7	2	6.7	4	7	1	6.3	3	5.8	1	7.7	1	20	-	-	5	10.2	-	-
	Guidance	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Parent	1	2.3	1	3.3	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1	-	-

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 11, science teachers give their students the most tasks and reinforcements to ensure they fulfill their tasks on time. In addition, some teachers stated that they emphasize communication with students. Sample responses of science teachers' practices regarding providing time on task are given.

"I give plus and minus in the lesson so that they do the tasks on time. I use the verbal grade for the tasks within certain criteria." ST6 (Reinforcement-Prize and Punishment; Task- Note)

"I use reinforcements" ST42 (Reinforcement- Reinforcement)

"Occasionally, I follow the student. I always keep the time between follow-ups different. Thus, the student thinks there will be an inspection at any time and does his homework and tasks on time." ST40 (Task- Responsibility (student))

"At this point, I give all the situations, such as when my task will be controlled, how I want it to be done, and how I will evaluate it. After all, I continue the process as I mentioned at the beginning. If the homework is not on time, I definitely do not take it. Sometimes, I indicate the date of the assignment at the beginning. I stated that I would score points for homework that was not brought in on time. I use the first method for short-term assignments. For long-term homework, I use the score-breaking method." ST55 (Task- Tell time and Check-in time)

"I award it as a smile, caress your head, or a nice pencil. I think the love we give to children can make them do anything." ST1 (Reinforcement- Prize; Communication- Motivation)

According to the examples given, science teachers use reinforcements to ensure the timely fulfillment of the tasks they assign to their students. They also assign the students responsibility for the task, check the homework on time, and motivate them to perform it.

The second part of the question was analyzed using three themes and 20 codes. Table 12 shows the science teachers' answers regarding the second part of the sixth question.

Table 12. Findings about the second part of the sixth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Reinforcement	Prize	10	23.2	3	10	10	17.5	3	18.8	11	21.2	1	7.7	-	-	1	50	10	20.4	3	12.5
	Reinforcement	4	9.3	1	3.3	5	8.8	-	-	4	7.7	-	-	1	20	-	-	3	6.1	2	
	Punishment	4	9.3	2	6.7	4	7	2	12.5	5	9.6	1	7.7	-	-	-	-	6	12.2	-	-
Task	Tell time	2	4.7	-	-	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	-	-	2	8.3
	Complete on time	-	-	1	3.3	-	-	1	6.3	-	-	1	7.7	-	-	-	-	1	2	-	-
	Check in time	-	-	3	10	2	3.5	1	6.3	1	1.9	2	15.4	-	-	-	-	2	4.1	1	4.2
	Responsibility (student)	3	7	4	13.3	6	10.5	1	6.3	5	9.6	2	15.4	-	-	-	-	6	12.2	1	4.2
	Responsibility (teacher)	-	-	2	6.7	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
	Working schedule	-	-	2	6.7	2	3.5	-	-	1	1.9	-	-	-	-	1	50	2	4.1	-	-
	Criterion	2	4.7	2	6.7	3	5.3	1	6.3	2	3.8	2	15.4	-	-	-	-	3	6.1	1	4.2
	Results	2	4.7	-	-	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	To the student	2	4.7	1	3.3	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
	Reminding	-	-	1	3.3	1	1.8	-	-	-	-	1	7.7	-	-	-	-	-	-	1	4.2
	Importance of time	5	11.6	4	13.3	6	10.5	3	18.8	6	11.5	2	15.4	-	-	1	50	6	12.2	3	12.5
	Appropriate levels	4	9.3	2	6.7	5	8.8	1	6.3	5	9.6	-	-	1	20	-	-	3	6.1	3	12.5
	Simple to complex	1	2.3	1	3.3	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	To assign a task to those who want	-	-	1	3.3	1	1.8	-	-	-	-	1	7.7	-	-	-	-	1	2	-	-
Communication	Motivation	1	2.3	1	3.3	-	-	2	12.5	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	Guidance	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	Parent	1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
Empty		10	23.2	7	23.3	15	26.3	2	12.5	12	23.1	2	15.4	3	60	-	-	9	18.4	8	33.3

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

Considering the teachers' suggestions to ensure that the tasks on time, according to Table 12, the most suggestion was to assign a task to the student was determined. In addition, reinforcement and effective communication are among other essential suggestions. Some crucial suggestions from science teachers about the time spent on tasks are given.

"I think the best way for students to do their assigned tasks on time is rewarding. In this way, the student performs their duties on time and ensures learning." ST11 (Reinforcement- Prize)

"Assigning duties in line with the student's wishes and ensuring the development of a sense of responsibility." ST7 (Task-Responsibility (student))

"I emphasize that a timely task is more permanent than a timelessly perfect one. The teacher's teaching time in the course should be short. A course flow should be arranged based on the active participation of students in equal time intervals. The teacher should not interfere with the student's break time and should use the time allocated for the lesson in a planned way. Moreover, the teacher should emphasize to his/her students that time is precious and that they should act accordingly." ST37 (Task- Importance of time)

"My recommendation is to create a sense of responsibility for the student, to understand the importance of the task, to guide him/her in this process, and to reward him/her. Also, incentives are significant." ST45 (Task- Responsibility (student); Communication – Guidance; Reinforcement- Prize)

According to the examples given, science teachers recommended fulfilling tasks on time, rewarding students who do their duties on time, developing task responsibility in students, understanding the importance of performing tasks on time, and guiding students in the process.

Findings Related to the Seventh Question of the QSP

The seventh question in the QSP aims to respond to high expectations, the sixth principle of the SPGP. In the first part, science teachers were asked what they did to answer high expectations, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed using six themes and 17 codes. Table 13 shows the answers of the science teachers regarding the first part of the seventh question.

Table 13. Findings about the first part of the seventh question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Individual development (teacher)		9	20.9	11	36.7	10	17.5	10	62.5	14	26.9	5	38.5	1	20	-	-	16	32.7	4	16.7
Communication	Orientation	2	4.7	1	3.3	3	5.3	-	-	3	5.8	-	-	-	-	-	-	1	2	2	8.3
	Encouragement	4	9.3	-	-	3	5.3	1	6.3	3	5.8	1	7.7	-	-	-	-	2	4.1	2	8.3
	Guidance	4	9.3	4	13.3	6	10.5	2	12.5	7	13.5	1	7.7	-	-	-	-	4	8.2	4	16.7
	Listening	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Parent	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Recognition	1	2.3	3	10	4	7	-	-	3	5.8	-	-	-	-	1	50	2	4.1	2	8.3
In-class	Student level	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Active participation	3	7	-	-	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	-	-	3	12.5
	Individual differences	-	-	1	3.3	1	1.8	-	-	1	1.9	-	-	-	-	-	-	-	-	1	4.2
	Task	1	2.3	1	3.3	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
	Prize	2	4.7	-	-	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
	Different activities	2	4.7	5	16.7	7	12.3	-	-	4	7.7	1	7.7	1	20	1	50	6	12.2	1	4.2
	High level activities	3	7	1	3.3	4	7	-	-	1	1.9	-	-	2	40	1	50	3	6.1	1	4.2
Out-of-class	Career choice	-	-	1	3.3	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Project etc.	1	2.3	1	3.3	1	1.8	1	6.3	1	1.9	1	7.7	-	-	-	-	1	2	-	-
	Access to resources	1	2.3	1	3.3	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
	Announce success	-	-	2	6.7	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
I am not doing anything extra.		1	2.3	1	3.3	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
Students do not have high expectations.		6	14	2	6.7	7	12.3	1	6.3	4	7.7	3	23.1	1	20	-	-	4	8.2	4	16.7
Empty		3	7	2	6.7	4	7	1	6.3	5	9.6	-	-	-	-	-	-	4	8.2	1	4.2

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 13, science teachers pay attention to communication with students, in-class activities, and their personal development to meet the high expectations of their students. In addition, some teachers say that they apply for extracurricular

activities to increase the high expectations of the students. However, only some teachers state that their students have low expectations. Some of the science teachers' opinions about the practices they make to meet high expectations are given.

"I am trying to update myself to make it more effective in my field. I am trying to follow the development of technology in my field." ST12 (Individual development (teacher))

"First, I get the student to know himself/herself." ST14 (Communication- Recognition)

"Since the expectations of the students are low, I try to make the students love my lesson to maximize their expectations, to gradually taste the sense of success, to show that the student has succeeded, and to help them become aware of their abilities. I set goals with the students and reward them when they succeed. Sometimes a chocolate, sometimes a compliment etc. I reward according to the situation." ST55 (Communication- Guidance, Encouragement; In-class- Active participation, Prize)

"I am giving project assignments." ST51 (Out-of-class- Project etc.)

"I have not yet witnessed that the students have high expectations from me. I guess I generally have high expectations. Students avoid questioning and asking questions; they turn to whatever is easy. They prefer to be given more information that is ready for them. It is difficult to think and comment." ST4 (Students do not have high expectations)

According to the examples, science teachers try to improve themselves to meet their students' high-level expectations, get to know them, encourage them, provide active participation, reward them, and carry out extracurricular activities. However, some teachers state that their students have low expectations.

The second part of the question was analyzed using four themes and 12 codes. Table 14 shows the science teachers' answers regarding the second part of the seventh question.

Table 14. Findings about the second part of the seventh question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Individual development (teacher)		9	20.9	7	23.3	10	17.5	6	37.5	12	23.1	3	23.1	1	20	-	-	13	26.5	3	12.5
Communication	Orientation	1	2.3	2	6.7	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
	Encouragement	2	4.7	1	3.3	3	5.3	-	-	2	3.8	1	7.7	-	-	-	-	2	4.1	1	4.2
	Guidance	2	4.7	-	-	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	1	2	1	4.2
	Listening	2	4.7	1	3.3	3	5.3	-	-	3	5.8	-	-	-	-	-	-	1	2	2	8.3
	Parent	1	2.3	-	-	1	1.8	-	-	-	-	-	-	-	-	1	50	1	2	-	-
	Recognition	1	2.3	1	3.3	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
In-class	Student level	1	2.3	-	-	-	-	1	6.3	1	1.9	-	-	-	-	-	-	1	2	-	-
	Task	2	4.7	2	6.7	4	7	-	-	3	5.8	1	7.7	-	-	-	-	4	8.2	-	-
	Different activities	3	7	2	6.7	5	8.8	-	-	2	3.8	1	7.7	1	20	1	50	2	4.1	3	12.5
	High level activities	3	7	3	10	6	10.5	-	-	4	7.7	2	15.4	-	-	-	-	3	6.1	3	12.5
Out-of-class	Physical facilities	-	-	2	6.7	2	3.5	-	-	1	1.9	1	7.7	-	-	-	-	2	4.1	-	-
	Project etc.	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
Empty		17	39.5	12	40	20	35.1	9	56.3	21	40.4	5	38.5	3	60	-	-	18	36.7	11	45.8

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 14, science teachers made suggestions to increase their personal development, give importance to communication with students, and pay attention to some points in in-class activities to meet the high expectations of their students. Some important suggestions given by science teachers for meeting the high expectations of students are given.

"We need to do research and master extracurricular topics." ST5 (Individual development (teacher))

"Every student's expectation should be answered without being seen as worthless or worthless." ST17 (Communication- Listening)

"I think it will contribute to learning if teachers raise their expectations to a higher level by providing learning environments that arouse curiosity in students." ST36 (In-class- Different activities)

"It is necessary to follow the student with studies that can be developed in the short, medium, and long term and to release his/her creativity in controlled areas where he/she can use it." ST19 (In-class- High-level activities)

"Since students are very impressed by the learning environment, the better opportunities are provided, the more expectations we can meet." ST46 (Out-of-class- Physical facilities)

According to the examples given, science teachers make recommendations for the teacher to develop himself/herself, listen to the students, create different learning environments, perform high-level activities, and improve physical conditions to meet the high expectations of their students.

Findings Related to the Eighth Question of the QSP

The eighth question in the QSP is about tolerance towards different learning styles, which is the seventh principle of the SPGP. In the first part, science teachers were asked what they did with tolerance towards different learning styles, and in the second part, teachers' suggestions were taken on this issue. The first part of the question was analyzed in a way that included three themes and 13 codes. Table 15 shows the answers of the science teachers regarding the first part of the eighth question.

Table 15. Findings about the first part of the eighth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different methods/ techniques	Methods	20	46.5	17	56.7	33	57.9	4	25	25	48.1	7	53.8	5	100	-	-	24	49	13	54.2
	Techniques	17	39.5	7	23.3	20	35.1	4	25	18	34.6	3	23.1	2	40	1	50	16	32.7	8	33.3
	According to majority	5	11.6	1	3.3	6	10.5	-	-	5	9.6	-	-	-	-	1	50	2	4.1	4	16.7
	Technology	8	18.6	3	10	9	15.8	2	12.5	10	19.2	1	7.7	-	-	-	-	6	12.2	5	20.8
In-class	Audio-visual different activities	9	20.9	3	10	10	17.5	2	12.5	10	19.2	2	15.4	-	-	-	-	5	10.2	7	29.2
	Different examples	2	4.7	1	3.3	2	3.5	1	6.3	2	3.8	1	7.7	-	-	-	-	3	6.1	-	-
	Different tasks	1	2.3	4	13.3	3	5.3	2	12.5	3	5.8	1	7.7	1	20	-	-	4	8.2	1	4.2
	Repeat the subject	1	2.3	2	6.7	2	3.5	1	6.3	1	1.9	2	15.4	-	-	-	-	2	4.1	1	4.2
Process	Learning style	6	14	6	20	8	14	4	25	8	15.4	3	23.1	-	-	1	50	10	20.4	2	8.3
	Simple to complex	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Easy to difficult	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Know the student	4	9.3	2	6.7	5	8.8	1	6.3	4	7.7	1	7.7	1	20	-	-	3	6.1	3	12.5
	Suitable environment	2	4.7	1	3.3	2	3.5	1	6.3	3	5.8	-	-	-	-	-	-	2	4.1	1	4.2
Empty		2	4.7	-	-	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	2	4.1	-	-

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 15, most science teachers stated that they mostly used different methods and techniques to help students with different learning styles learn. In addition, some science teachers stated that they pay attention to learning principles in the learning process and try to get to know students. Also, some science teachers pay attention to diversity in in-class activities. Some opinions of science teachers about their practices to tolerate students with different learning styles are given.

"While explaining a subject, I try to address many sensory organs. For example, while explaining the subject of 8th-grade chemical bonds, I make them understand bond formation with the drama technique, I show the bond formation video and visual from the smart board, and I try to explain why the bond should be formed cognitively." ST24 (Different methods/ techniques- Techniques, Technology)

"I mostly use laboratory technique, visuals, video pictures on the smart board, and cooperative learning methods." ST44 (Different methods/ techniques- Methods, Techniques, Technology; In-class- Audiovisual different activities)

"I prepare a learning environment by considering the learning styles of these students. For example, some students learn better when associated with daily life. Some students also learn by experimenting or practicing at school. This way, I try to meet the needs of the students." ST72 (Process- Learning style)

"I must fill out a recognition receipt or form to get to know the students. Then, I design different learning activities suitable for them. I do group, cluster, and workshop work in the classroom and interact with students with different learning abilities." ST45 (Process- Learning style, Know the student)

According to the examples, science teachers use various teaching methods and techniques to reach students with different learning styles, use technology, consider students' learning styles, and try to get to know students.

The second part of the question was analyzed using three themes and 12 codes. Table 16 shows the science teachers' answers to the second part of the eighth question.

Table 16. Findings about the second part of the eighth question in the QSP

Themes and codes*		Gender				Type of School				Experience (Seniority)								Region			
		Women		Men		SS		PS		1-5		6-10		11-15		16-20		E		W	
		f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Different methods/ techniques	Methods	11	25.6	8	26.7	13	22.8	6	37.5	14	26.9	4	30.8	1	20	-	-	16	32.7	3	12.5
	Techniques	12	27.9	7	23.3	13	22.8	6	37.5	15	28.8	3	23.1	1	20	-	-	15	30.6	4	16.7
	Technology	2	4.7	-	-	1	1.8	1	6.3	2	3.8	-	-	-	-	-	-	1	2	1	4.2
In-class	Audio-visual different activities	5	11.6	3	10	7	12.3	1	6.3	7	13.5	1	7.7	-	-	-	-	4	8.2	4	16.7
	Different tasks	1	2.3	1	3.3	2	3.5	-	-	-	-	1	7.7	-	-	1	50	2	4.1	-	-
Process	Learning style	2	4.7	2	6.7	2	3.5	2	12.5	2	3.8	2	15.4	-	-	-	-	2	4.1	2	8.3
	Interest	1	2.3	-	-	1	1.8	-	-	1	1.9	-	-	-	-	-	-	1	2	-	-
	Level	2	4.7	-	-	2	3.5	-	-	2	3.8	-	-	-	-	-	-	2	4.1	-	-
	Types of intelligence	2	4.7	2	6.7	3	5.3	1	6.3	4	7.7	-	-	-	-	-	-	2	4.1	2	8.3
	Individual differences	3	7	7	23.3	9	15.8	1	6.3	6	11.5	3	23.1	-	-	1	50	6	12.2	4	16.7
	Know the student	9	20.9	4	13.3	12	21.1	1	6.3	11	21.2	1	7.7	1	20	-	-	8	16.3	5	20.8
	Suitable environment	4	9.3	5	16.7	8	14	1	6.3	8	15.4	1	7.7	-	-	-	-	5	10.2	3	12.5
Empty		8	18.6	6	20	10	17.5	4	25	10	19.2	1	7.7	2	40	-	-	11	22.4	3	12.5

*Some teachers commented on more than one theme and code. SS: State school, PS: Private school, E: East, W: West

According to Table 16, most science teachers had suggestions for considering various factors, such as recognizing the student, creating an appropriate learning environment in the learning process, and using different methods and techniques in lessons to ensure students with different learning styles learn. Some opinions of science teachers about the applications that can be done for students with different learning styles are given.

"A teacher needs to know alternative learning methods. After gaining this knowledge, he should observe the students, determine a method for the student, and use that method in the lesson." ST65 (Different methods/ techniques- Methods, Techniques)

"If I have students with different learning styles, instead of teaching monotonous lessons in the classroom, I use different methods to help them become activated. For example, I participate in the lesson by asking questions to students who do not attend the lesson. If we are solving a problem, I have a student removed. I can recommend them." ST67 (Different methods/ techniques- Techniques)

"Students can be guided and assigned by considering individual differences. No matter how much you try to do this in the classroom environment, I think a moderate line can be followed." ST7 (In-class- Different tasks; Process- Individual differences)

"Using different teaching methods is not an easy task. Therefore, the factors that hinder learning in the classroom environment should be eliminated. Students with different learning strategies should be determined in advance and planned accordingly.

Activities for each learning area should be selected." ST37 (Process- Individual differences, Know the student, Suitable environment)

According to the examples, science teachers suggest using different teaching methods and techniques to ensure the active participation of students with different learning styles. They should give students different tasks, pay attention to individual differences, and try to recognize students and create appropriate learning environments.

DISCUSSION

In this study, science teachers' level of knowledge about SPGP was low. The majority of the teachers had yet to learn about SPGP. In this context, there was no difference in the teachers' answers according to gender, school type, experience (seniority), and school region. Teachers' lack of theoretical knowledge about the seven principles may be due to the limited number of practical studies on the seven principles. Another factor may be that teachers working in secondary schools need to be made aware of the SPGP since it is emphasized in undergraduate education. However, most teachers reasoned about what SPGP could be and provided partially correct answers. Although the teachers did not know the SPGP by name, they applied it in their lessons. In parallel with this study's results, science teachers' opinions in previous studies on SPGP were at low and medium levels (Koç et al., 2014; Öztürk et al., 2013).

Famale teachers emphasized out-of-class activities and communication to increase student-school interaction (Principle 1). In comparison, male teachers gave more importance to in-class and out-of-class activities. In studies, women have better communication skills (Bugay & Korkut Owen, 2016; Gölönü & Karcı, 2010; Taşkın et al., 2010). Teachers working in public schools paid more attention to in-class and out-of-class activities. In contrast, teachers working in private schools paid particular attention to active participation in the classroom. In private schools, students' success is critical to increase the school's recognition. In this respect, it may be aimed to increase communication with students in classroom practices. When the teachers' responses in terms of experience were analyzed, social activities outside the classroom were used more frequently as experience increased. This situation can be interpreted as teachers develop themselves more socially as their professional experience increases and their interaction with their students' increases. Similarly, the preference for in-class activities to increase student-school interaction generally increases with increasing experience. Here, teachers' getting more accustomed to the profession with increasing experience is adequate. However, all teachers mostly used in-class activities to increase student-school interaction. On the other hand, teachers with 1-5 years of experience were also found to conduct out-of-class activities to increase student-school interaction. This situation can be interpreted as novice teachers being more oriented towards out-of-class activities as they adapt to the school. When teacher responses regarding the region were analyzed, teachers working in the East and West of the country generally gave similar responses.

When we look at the teachers' suggestions to increase student-school interaction, women mostly suggested in-class activities and giving importance to communication, while men suggested giving importance to communication. This situation may be based on teachers knowing that communication is essential in student-school interaction. Teachers working in public and private schools stated that communication should be necessary. In addition, teachers working in public schools stated that in-class activities should be increased. According to these suggestions for increasing student-school interaction, the fact that there are not many environments suitable for out-of-class activities in some public schools may have prompted teachers to spend more productive time with their students in the classroom. While teachers with 1-5 years and 6-10 years of experience emphasized the importance of communication to increase student-school interaction, teachers with 11-15 years and 16-20 years of experience mainly emphasized increasing in-class activities. Teachers with less professional experience tend to increase their communication skills. Teachers working in the East stated that more emphasis should be placed on communication to improve student-school interaction. In contrast, teachers in the West stated that more emphasis should be placed on classroom activities. Since newly appointed teachers usually work in the East of the country, this result is parallel between professional experience and the region of work.

Both male and female teachers mostly used in-class activities to increase student cooperation (Principle 2). Especially male teachers spent more time on group work. According to school type, professional experience, and region of assignment, all teachers did more in-class activities to increase student cooperation. Considering that students spend most of their time in the classroom, the easiest way to increase student interaction and cooperation is to work together in classroom activities. Lalit and Piplani (2019) and Sormunen et al. (2020) emphasized the importance of collaboration to ensure active learning of individuals. They stated that active learning increases the participation of individuals in the learning process in an environment of collaboration.

When the teachers' suggestions regarding cooperation among students were examined, male and female teachers had similar views on increasing communication and conducting in-class activities. Teachers working in public schools suggested cooperative learning and different activities, while teachers working in private schools suggested group work. Regarding professional experience, teachers' responses were similar, and they recommended more in-class activities. Regarding the assignment region, teachers in the East recommended implementing more in-class activities. Considering that the East of the country is less socioeconomically developed and that newly appointed teachers usually work in villages or small settlements in the East, they can provide the most communication with students in school. Because in small settlements, children can work in fields and gardens

to help their families outside of school. In this context, it is natural for teachers to suggest in-class activities to develop cooperation among their students.

Male and female teachers used different techniques to increase active learning and emphasized active participation (Principle 3). Active learning requires the individual to participate in the process and learn by doing and experiencing (Açıkgöz, 2003). In this context, the most appropriate way is to apply different methods and techniques. It is assumed that teachers also think in this way. Teachers working in public schools used different methods and techniques and emphasized communication. Teachers working in private schools give higher importance to learning by doing and experiencing. Learning a subject by doing and experiencing increases the permanence of what is learned (Karaçöp & Doymuş, 2013; Okumuş et al., 2017). In this context, private schools may give more importance to this type of activity to ensure permanent learning. When the data were analyzed regarding experience, the teachers paid attention to similar characteristics. Also, all teachers emphasized using different techniques and learning by doing and experiencing. To ensure active learning, the individual must personally participate in the learning process (Açıkgöz, 2003). Therefore, learning by doing and experiencing is also active learning.

Teachers may use different methods and techniques to reach students with various learning styles. In addition, experienced teachers gave importance to responsibility by providing communication. The more experience one has, the easier it is to know how to behave in the face of different events. In this context, experienced teachers may have thought that communication with students would facilitate active learning. They may also have encouraged them to participate by giving them responsibilities. Teachers working in the western region paid greater attention to learning by doing and experiencing to ensure active learning. Better facilities for schools in the West may effectively address this situation.

Female teachers gave more hints and feedback to their students to give timely feedback (Principle 4). Male teachers, on the other hand, stated that they asked more questions to get feedback from their students. Feedback is critical in understanding a subject correctly, determining whether the student understands the subject, and seeing the student's level. In this context, teachers must give timely and appropriate feedback during the lesson. Providing prompt feedback in lessons has a clear and positive relationship with student achievement and satisfaction (Chickering & Gamson, 1999; Phelps, 2019). Giving hints on the subject that the student does not understand and answering his/her question will motivate him/her more to the lesson. In this context, female teachers may have prioritized student motivation. To get feedback from students, it is usually necessary to ask them questions. With the help of questions, it is revealed what the student knows, what he/she has learned, what he/she has not learned, and what he/she knows wrong. In this framework, male teachers tend to ask questions for feedback. Teachers working in public schools gave more feedback and hints, while teachers working in private schools gave homework. Since private schools usually compete with other schools, teachers may assign homework to increase the level of their students. Teachers generally gave feedback on time for immediate feedback. As the teachers' experience increased, the rate of asking questions for feedback also increased. This situation may be because experienced teachers know their students better or they think that by asking students various questions, they will better reveal what they know and do not know. Teachers working in the East carried out different practices to realize this principle, giving hints, rewards, and asking questions, while teachers in the West mostly gave feedback.

When the teachers' suggestions for giving feedback were examined, female teachers suggested feedback, asking questions, and making tests/quizzes. Male teachers, on the other hand, emphasized communication more. From this point of view, the teachers suggested different practices than what they did. While teachers in public schools suggested using clues/prizes and asking questions more, teachers in private schools suggested using different applications, feedback, and communication more. This situation may be due to the desire of private schools to keep their communication with their students high and be at the forefront in the sector. When the teachers' suggestions in terms of experience were analyzed, teachers with 1-5 years and 6-10 years of experience suggested more feedback. From this, novice teachers recommend more feedback to focus on the process. When teachers' suggestions were analyzed regionally, teachers in the East suggested more prompting, rewarding, asking questions, and communication, while teachers in the West suggested tests/quizzes. Teachers in the West are generally more experienced and know their students better. In this context, they may have suggested taking the opinions of their students about the subject with quizzes, which is different from the applications made in this context.

Female teachers used reinforcers more frequently to ensure that tasks were completed on time, told the due dates of the assignments, and paid more attention to grading and ensuring student responsibility (Principle 6). On the other hand, male teachers paid more attention to completing assignments on time, checking them on time, preparing a schedule, reminding students about the assignment, and mentioning the criteria. The timely completion of assignments depends on the teacher's attitude. Teachers who control their homework on time motivate their students to do their homework on time. Because when students know that their homework will be checked on time, they pay more attention to the homework and do not avoid taking responsibility. In this context, teachers' practices motivate students to do their homework on time. Public school teachers gave more reinforcements to their students to complete the tasks on time, while private school teachers practiced more in creating a work schedule and paying attention to communication. In private schools, student performance is an essential point for the promotion of the school. For this reason, teachers working in private schools pay more attention to their students' individual development. It is thought that teachers create individual study calendars for their students. In terms of experience, teachers have similar practices. However, teachers with 1-5 years of experience paid more attention to communication. The efforts of novice teachers to get to know their students may be influential in the emergence of this situation. Teachers pay more attention to

communication with their students to get to know them better. Regionally, teachers' practices were similar, and they focused more on giving reinforcement. Reinforcements generally increase the frequency of behaviors and positively affect learning. Based on this idea, teachers reinforce students who perform their tasks on time.

When the teachers' suggestions for ensuring that time on tasks were examined, female teachers suggested using reinforcers, while male teachers suggested assigning tasks more. While teachers working in public schools suggested communication, teachers working in private schools suggested tasks. Accordingly, teachers suggested practices other than their own on the subject. When the teachers' suggestions in terms of experience were analyzed, they generally focused on the task. Assigning tasks increases student responsibility (Anderson, 2018). Tasks encourage students to work more systematically (Dessem, 1999). In this respect, tasks are essential for student development. When teachers' suggestions were analyzed regionally, teachers working in the East suggested more reinforcement, tasks, and communication. The high number of new teachers in the East can explain this.

To respond to the high expectations of the students, female teachers gave more importance to communication and conducted in-class activities. From this, female teachers try to reach students by establishing proper communication. Male teachers, on the other hand, spent more time on in-class and out-of-class activities. Male teachers mostly try to develop students' expectations through activities. Teachers working in public schools emphasized communication and in-class and out-of-class activities. On the other hand, teachers working in private schools gave more importance to individual development. Since performance is essential in private schools, teachers encourage their students to set high goals by ensuring their individual development. Looking at the practices of teachers in terms of experience, teachers with 1-5 years of experience gave more importance to communication, teachers with 6-10 years of experience gave more importance to individual development, and teachers with 11-15 years and 16-20 years of experience gave more importance to in-class activities. Novice teachers primarily try to get to know their students and, therefore, give importance to communication. As the experience of the teachers increased, they tried to improve the high-level expectations of their students by making different practices. While teachers working in the East gave more importance to individual development and out-of-class activities, teachers working in the West gave more importance to communication and in-class activities. New teachers in the East tend to focus more on out-of-class activities to ensure their students' individual development. On the other hand, experienced teachers in the West can be inferred that they progress by communicating with their students in the classroom to have high-level attainable expectations.

When the teachers' suggestions for directing teachers to higher-level reachable expectations were analyzed, female and male teachers offered similar suggestions for individual development. However, while female teachers suggested increasing communication, male teachers suggested using in-class activities. Teachers' suggestions are parallel to their practices. While teachers working in public schools suggested communication and in-class and out-of-class activities more, teachers working in private schools focused more on individual development. There is also a harmony between teachers' practices and their suggestions. In terms of professional experience, teachers with 1-5 years of experience suggested considering individual development more, while teachers with 6-10 years of experience suggested using in-class activities more. Teachers with 1-5 years of experience stated that they gave importance to communication, while teachers with 6-10 years of experience stated that they gave importance to individual development. According to this, teachers recommend implementing practices that they do little. From this, teachers have different ideas for improving their students' high-level attainable expectations. Teachers working in the East emphasized individual development and out-of-class activities to meet students' high expectations. In contrast, teachers working in the West suggested more in-class activities. This suggestion is also in line with teachers' practices.

Most male and female teachers stated that they used different methods and techniques to involve students with different learning styles in the learning process (Principle 7). According to the multiple intelligences model, each individual has more than one type of intelligence, and the dominant types of intelligence are effective in learning (Davis et al., 2011; Gardner, 1999). In this context, the fact that students have different learning styles is related to the multiple intelligences model. At this point, it is expected that the practice will use different learning methods and techniques to reach more students. While teachers working in public schools stated that they made different applications more frequently, teachers working in private schools paid more attention to in-class applications—teachers with less experience utilized technology more. Especially in the last 20 years, the rapid technological change has affected education as it has affected all fields. Since young teachers are more familiar with technology-related applications in their daily lives, using more technology in their lessons is normal. In addition, some studies state that senior teachers are inadequate in technological applications (Ardıç, 2020; Cin, 2023). In this study, the use of different methods increased with increasing experience. This situation can be explained by the fact that teachers who are better adapted to the process can make different applications more efficient. Teachers working in the West used different methods and techniques and gave more importance to visual applications. Since the professional experience of teachers working in the West is generally higher, this situation can be related to the previous explanation. On the other hand, teachers working in Eastern cities stated that they did more in-class applications and auditory activities and considered students' learning styles. Since young teachers are in the process of adaptation, they may spend more time on classroom practices. In addition, it is thought that active learning methods suitable for constructivism, which they learned in the pre-service period, are effective in young teachers' considering different learning styles.

When the teachers' suggestions regarding the participation of students with different learning styles in the lesson were examined, female teachers mostly suggested using different methods/techniques and doing practices to get to know the students. Female teachers may think that student recognition is one of the priorities in the education process. Male teachers, on the other

hand, mostly suggested considering individual differences and creating appropriate learning environments. Accordingly, male teachers may have thought that students can be reached more effectively by providing learning environments suitable for student differences. Teachers working in public schools suggested more in-class activities, considering individual differences and recognizing students to involve students with different learning styles in the process. On the other hand, teachers working in private schools suggested using different methods/techniques and considering students' learning styles. From this, teachers working in public and private schools recommend practices different from their practices for effectively teaching students with different learning styles. In terms of experience, the teachers' answers were similar, and they mostly suggested using different learning methods/techniques. From this, there is a similarity between what teachers do and the practices they recommend. Teachers working in the East suggested using different methods/techniques, while teachers in the West suggested audiovisual applications and paying attention to the teaching-learning process. Since teachers in the West are generally more experienced, as their experience increases, they consider different factors.

CONCLUSION AND RECOMMENDATIONS

When the results obtained in the study are analyzed in general, although science teachers are not sufficiently familiar with the term "seven principles for good practice," they do the practices related to each principle. When evaluated in terms of gender, primarily male and female teachers' responses were close to each other, and they made different practices in some principles. When the results were analyzed in terms of school type, although the results were generally similar, the answers, such as giving more importance to individual development and creating a work schedule, were more common in private schools. In contrast, different activities were used in public schools, and feedback and reinforcement were given. When evaluated in terms of seniority, practices such as using different activities, communication, asking questions, and using different methods generally increased as experience increased. When evaluated in terms of the region of assignment, although they generally gave similar answers, teachers in the West emphasized learning by doing, communication, using different methods and techniques, and visualization. In contrast, teachers in the East emphasized hints, reinforcement, individual development, and taking into account learning styles.

For future studies, it would be helpful to provide in-service training to improve the practices of science teachers for each principal. Again, it is predicted that integrating different teaching methods and techniques into the process by evaluating them in the context of the seven principles will improve students' communication with school, teachers, and friends. In this context, considering and integrating the seven principles into the education and training process in all aspects will positively contribute to science learning processes.

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Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

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Topic Trend Analysis of Postgraduate Theses on Organizational Commitment in the Field of Education

Eğitim Alanında Örgütsel Bağlılık Konulu Lisansüstü Tezlerin Konu Trend Analizi

Emine Didem BİBER[1]

Abstract

Purpose: The purpose of this research is to conduct topic trend analyses of postgraduate theses addressing the subject of "organizational commitment" in education.

*Design/Methodology/*Approach: In the study, the document review method was used to describe and interpret the tendencies of the theses in depth. The data required for the research was generated from the theses with the help of a form created by the researcher. Of the 403 theses scanned this way, 45 were doctoral, and 358 were master's.

Findings: As a result of the analyses, it was determined that the first theses on the subject were completed in 2004. Foundation universities were ahead in the number of master's theses, but doctoral theses in foundation universities were almost nonexistent. In addition, it was observed that in nearly all the theses designed in relational screening, teachers and principals were preferred as the sample group, and primary and secondary schools were selected as the study field. The main factors affecting organizational commitment discussed in the theses were classified as "organizational climate," "individual factors," and "manager." These factors were distributed evenly in the theses.

Highlights: Organizational commitment is a fundamental concept for educational organizations. It is essential to examine how the subject of "organizational commitment" is addressed in the field of education in postgraduate theses whose scientific validity and reliability have been approved in terms of depth and scope.

Öz

Çalışmanın amacı: Bu araştırmanın amacı, eğitim alanında "örgütsel bağlılık" konusunu ele alan lisansüstü tezlerin konu trend analizlerini yapmaktır.

Materyal ve Yöntem: Çalışmada, tezlerin eğilimlerinin derinlemesine betimlenebilmesi ve yorumlanabilmesi için doküman incelemesi yöntemi kullanılmıştır. Araştırma için gerekli veriler, araştırmacı tarafından oluşturulan bir form yardımıyla tezlerden üretilerek elde edilmiştir. Bu şekilde taranan toplam 403 tezin 45 tanesi doktora, 358 tanesi ise yüksek lisans çalışmasıdır.

Bulgular: Yapılan analizler neticesinde, konu hakkında ilk tezlerin 2004 yılında tamamlanmış ve o yıldan itibaren genel olarak tez sayısının artış trendinde olduğu, yüksek lisans tez sayıları dikkate alındığında vakıf üniversitelerinin ön planda oldukları, buna karşın vakıf üniversitelerinde tamamlanmış doktora tezlerinin yok denecek kadar az olduğu tespit edilmiştir. Ayrıca neredeyse tamamına yakınının ilişkisel tarama şeklinde desenlenen tezlerin büyük bir çoğunluğunda örneklem grubu olarak öğretmenlerin ve okul müdürlerinin tercih edildiği, tezlerin yine büyük bir bölümünde ise çalışma sahası olarak ilk ve orta öğretim okullarının tercih edildiği görülmüştür. Literatür de dikkate alındığında tezlerde konu edilen örgütsel bağlılığı etkileyen ana faktörler "örgütsel iklim", "bireysel faktörler" ve "yönetici" olarak sınıflandırılmıştır. Buna göre hem yüksek lisans hem de doktora tezlerinde bu faktörlerin dengeli olarak dağıldığı söylenebilir..

Önemli Vurgular: Örgütsel bağlılık eğitim örgütleri için oldukça önemli bir kavramdır. Derinlik ve kapsam konusunda bilimsel olarak geçerlilikleri-güvenilirlikleri onaylanmış lisansüstü tez çalışmalarında eğitim alanında "örgütsel bağlılık" konusunun nasıl ele alındığının incelenmesi önem arz etmektedir.

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INTRODUCTION

A qualified workforce is one of the essential elements that companies should consider when planning for the future (Şerbetçi, 2003). According to Eskandaricharati (2013), high employee motivation and business commitment are essential for businesses to continue their existence. Organizational commitment means a person's emotional responses to the characteristics of the organization they work for. Employees' organizational commitment is significant for business success (Kara, 2019; Majid & Afifa, 2017). According to Steers (1981), organizational commitment includes individuals' desire to take an active role in the success of their organization and the achievement of its goals beyond passive loyalty to the organization. Therefore, organizational commitment is a broad concept that includes employees' voluntary participation in activities that will move the company forward, and it means more than just the emotional bond established with the company. According to Uygur (2009), employees must believe in the organization's goals in order for organizational commitment to occur. This way, the employee strongly desires to work to benefit the organization. Organizational commitment is determined by the employees' relationship with the organization and is a psychological behavior that ensures their continued stay in the organization (Özdevecioğlu, 2003). Demir and Öztürk (2011) defined organizational commitment as individuals giving more importance to the organization's interests than other factors. According to Reichers (1985), the desire to stay in the organization results from organizational commitment.

Organizational Commitment

The literature examines organizational commitment as "attitudinal commitment" by organizational behavior researchers and "behavioral commitment" by social psychologists. The literature examines organizational commitment as "attitudinal commitment" by organizational behavior researchers and "behavioral commitment" by social psychologists. In general, attitudinal commitment is used in the sense of organizational commitment. Attitudinal commitment is a transactional relationship in which individuals bind themselves to the organization in return for some moral rewards and benefits (Mowday et al., 1979). Attitudinal commitment can be evaluated as the overlap between the goals and values of the employee and the goals and values of the institution (Woods, 2007). There is a positive relationship between the benefits that employees provide for the organization and the degree of organizational commitment (İnce & Gül, 2005). In attitudinal commitment approaches, commitment dimensions that include emotional, continuity, and normative elements come to the fore.

Although there are different classifications in the literature, one of the most accepted classifications is the Allen and Meyer approach. According to this approach, organizational commitment is addressed in three groups: "emotional," "continuance," and "normative (moral)" commitment (Allen & Meyer, 1990; Meyer et al., 1993). The "emotional commitment" concept emerges from the employee forming an emotional bond with the organization (Demirel, 2008). Emotional commitment is the emotional closeness the employee feels towards the organization. Employees with high emotional commitment work happily in the organization by integrating their values with the values of the organization (Çetin, 2004). Continuity commitment means the employee knows the costs of leaving the job and the organization. In this type of commitment, employees stay in the organization because they need it (Meyer et al., 1993). Continuity commitment occurs due to employees' fear of losing their careers, social status, and living standards, which they have worked hard for years, in the event of leaving the organization (Yalçın & İplik, 2005). Normative (moral) commitment is when the employee feels obliged to continue working (Shurbagi & Zahari, 2014). Moral commitment is defined as the situation in which employees see themselves as responsible and obliged to the organization, feel morally indebted to their organization for various reasons, and believe that they must continue working in order to pay their debts (Çetin, 2004; Gürkan, 2006). According to Allen and Meyer (1990), employees are primarily expected to have a high emotional commitment (Yalçın & İplik, 2005). Those who explain organizational commitment with behavioral commitment define it according to the employee's behavioral habits. In other words, behavioral commitment develops in the person's behavior rather than the organization (Paine, 2007). When an employee adopts a behavior within the organization and makes it a habit, there is a behavioral commitment (Mowday et al., 1982). Membership initiation ceremonies of some social clubs, military institutions, or religious orders can be examples of establishing such a commitment.

Factors Affecting Organizational Commitment

Individual Factors

Demographic characteristics such as employees' age, gender, education level, and seniority are the main factors affecting organizational commitment. In addition, employees' psycho-social characteristics, motivations, and work values are also evaluated among the factors affecting organizational commitment (Balay, 2000, pp. 55-61). As seniority and age in the organization increase, the employee's benefits and organizational commitment will increase (Yalçın & İplik, 2005, p. 400). As the employee's level of education increases, organizational commitment tends to decrease due to higher expectations and increasing new job opportunities (Yalçın & İplik, 2005, p. 400).

Factors related to the job and the role

The job's content, scope, and descriptions are the essential components of the factors related to the job and role. In addition, the organization's management style, the reward system, the learning opportunities offered to the employees, and the workload are added to these factors (Özdevecioğlu, 2003, p. 115).

Factors Related to Work Experience and Working Environment

According to Allen and Meyer (1990), the degree of organizational commitment of new employees can vary even in 6 months. A positive correlational relationship exists between the length of time employees stay in the organization and their degree of organizational commitment. However, a negative correlational relationship exists between the length of time spent in the same position and organizational commitment (Balay, 2000, p. 58). This factor group also examines employee-manager relationships, organizational climate, and organization reliability and job satisfaction. Job satisfaction is one of the most critical factors determining organizational commitment (Özdevecioğlu, 2003, p. 116). Employees who are unsatisfied with their jobs either intend to leave or may be disinterested in their jobs. Job satisfaction refers to the attitude that an employee develops towards their job, while organizational commitment refers to the attitude that an employee develops towards their organization (Human Resources, 2001a).

Factors Related to Organizational Structure

The organization's image and corporate structure are the most critical factors for organizational commitment. Flexible working hours, a fair and satisfactory wage system, accessible career opportunities, and unionization are also thought to positively affect organizational commitment (Özdevecioğlu, 2003, p. 116).

Purpose of the Research and Sub-Problems

Business science deals with every aspect of social life. This situation brings with it contact with other branches of science. It is possible to see the most concrete examples of this, especially in theses. These are comprehensive scientific studies with scientific depth whose validity and reliability have been approved by expert academics. These also make meaningful suggestions for solving social problems thanks to the new information they produce (Efilti Atay, 2018, p. 1407).

For this reason, it is essential to address social problems in theses (Çakır, 2017, p. 315; Yılmaz et al., 2017: 138). Organizational commitment strongly correlates with behavioral results (İnce & Gül, 2005). The more positive attitudes of those working in schools towards the educational community, the more vital education and training will be.

For this reason, organizational commitment is also a fundamental concept for educational organizations (Bolat & Bolat, 2008). There is a solid and positive relationship between organizational commitment and employee retention. Organizational commitment and employee turnover rate are negatively related (Steers, 1977). Examining how "organizational commitment" is addressed in postgraduate theses whose scientific validity and reliability have been approved in depth and scope is essential. Therefore, the main problem of this research is formed as follows: "What are the topic-trend analyses of postgraduate theses addressing the subject of 'organizational commitment' in the field of education?" Topic-trend analysis aims to evaluate scientific studies published in the relevant field from various aspects (Law & Cheung, 2008: 81). The results obtained by the topic-trend analysis conducted on a large sample will shed light on new scientific research by defining gaps related to the research topic (Lara-Rodriguez et al., 2019, p. 261). In this study, answers will be sought to the following sub-problems within the scope of the research problem:

1) What is the distribution of theses addressing the subject of 'organizational commitment' in the field of education by year?
2) What is the distribution of theses by the universities where they were produced?
3) What are the sample groups examined in the thesis?
4) What are the fields of study in theses?
5) What are the methods discussed in the thesis?
6) What are the main factors affecting organizational commitment?
7) What are the concepts examined about organizational commitment in theses?

METHOD/MATERIALS

This research used the document review method to describe and interpret the trends of postgraduate theses dealing with "organizational commitment" in business administration. In the document review, analyses are made in line with the problems addressed in the research (Yıldırım & Şimşek, 2016).

Sample of the Research

The data used in the research were obtained from theses reached as a result of the search made by typing "organizational commitment" in the thesis title section and "Education and Training" in the subject section in the search engine of the National Thesis Center of the Council of Higher Education in February 2024. Of the 403 theses scanned this way, 45 were doctoral, and 358 were master's studies.

Data Collection Tool

The data required for the research were produced from these using a form created by the researcher. The form includes the theses' identities and the research sub-problems created by scanning the relevant literature.

Validity and Reliability Studies

The validity and reliability of this research are directly proportional to the validity and reliability of the theses examined (Tavşancıl & Demiray, 2013). These scientific researches are officially approved by an academic jury of at least three people and

the Council of Higher Education. Therefore, it is assumed that there will be no doubt about their validity and reliability. However, in this study, the theses were also evaluated separately by the researcher and another academician who is an expert in mathematics education. Then, the statistical agreement of the data obtained as a result of two different evaluations was examined (Şimsek & Yıldırım, 2011). The agreement rate of the data recorded in an Excel file was calculated using the formula of Miles and Huberman (1994) [Reliability = Consensus / (Consensus + Disagreement)] and was determined to be 87%. This rate of above 70% shows that the study is reliable (Miles & Huberman, 1994). Finally, the researcher and the expert reached a consensus for the cases where there was inconsistency.

Data Analysis

In this study, where the subject trend analyses of the theses used in the research were conducted, the descriptive analysis technique was used. According to Şimşek and Yıldırım (2011), in descriptive analysis, similar data are analyzed within the framework of specific themes and concepts. The data obtained from the research were recorded in an Excel file. Then, the necessary analyses were made within the framework of new themes created by considering the sub-problems. The results were given in the form of tables and interpreted.

FINDINGS

The findings obtained from theses according to the determined criteria are discussed in this section in the order of subproblems. The findings regarding the answer to the question of the first sub-problem, "What is the distribution of theses addressing the subject of 'organizational commitment' in the field of education by year?" are given in Figure 1.
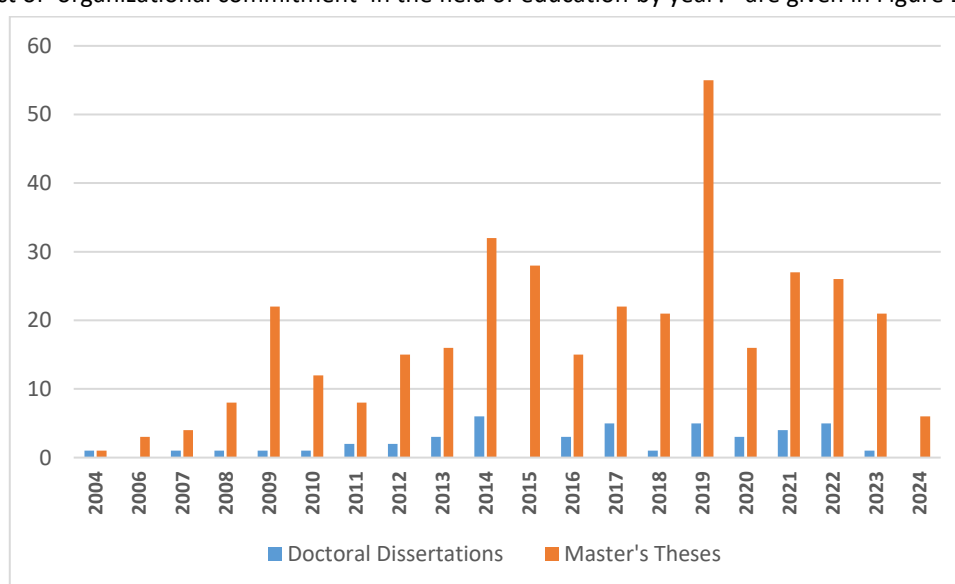
Figure 1. Number of Theses Written by Year

When the distribution of theses by year is examined, it can be said that the first studies (2 theses) addressing the subject of 'organizational commitment' in the field of education were conducted in 2004, and the number of theses gradually increased in the following years and varied between 10 and 30 between 2009 and 2023.

The findings regarding the answer to the second sub-problem, "How are these distributed according to the universities where they were produced?" are presented in Figure 2 and Figure 3.
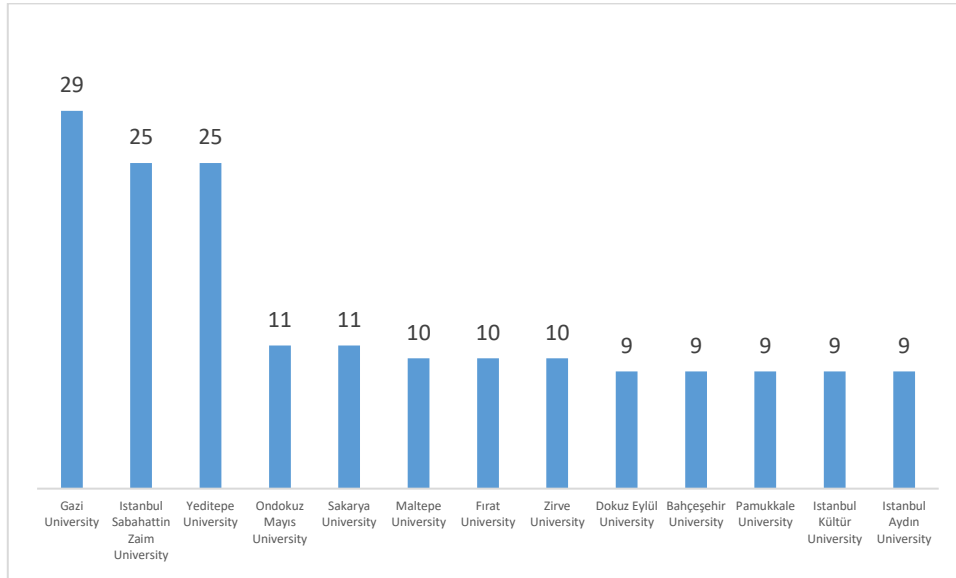
Figure 2. Distribution of Master's Theses by University

Figure 2 shows the universities that have produced at least nine master's theses on the subject. When the distribution of theses by university is examined, it is seen that Gazi University is in first place with 29 theses. The second place is shared by two foundation universities, Yeditepe and Istanbul Sabahattin Zaim, with 25 theses each. The ranking given in the graph also draws attention to the weight of foundation universities such as Maltepe, Zirve, Istanbul Kültür, and Istanbul Aydın University on this list.

The distribution of doctoral dissertations completed on the subject by the university is given in Figure 3.
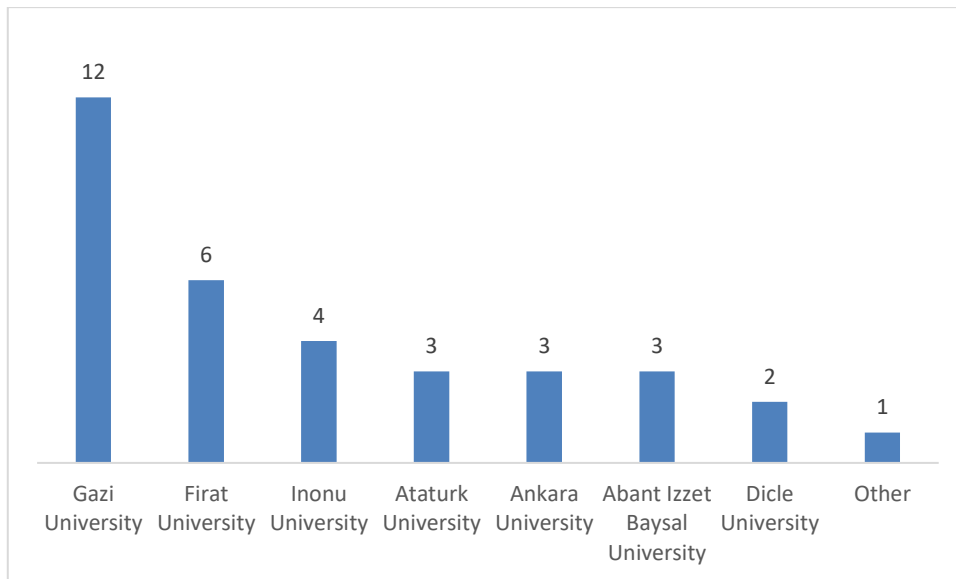
Figure 3. Distribution of Doctoral Dissertations by University

Graph 3 shows the distribution of 45 doctoral dissertations completed by the university; Gazi University is again ahead of other universities with 12 theses. Another striking point is that no foundation university is included in this list.

The findings regarding the answer to the third sub-problem, "What are the Sample Groups examined in the theses?" are given in Table 1.

Table 1. Sample Groups Examined in Theses

Sample Groups	Doctoral Dissertations		Master's Thesis		Grand Total	
	f	%	f	%	f	%

Teachers	31	68,9	245	68,4	276	68,5
School Principals-Teachers	9	20,0	83	23,2	92	22,8
Academician	3	6,7	15	4,2	18	4,5
School Principals	1	2,2	12	3,4	13	3,2
Ministry of National Education Experts	1	2,2	1	0,3	2	0,5
University Students			1	0,3	1	0,2
Education Inspectors			1	0,3	1	0,2
Grand Total	**45**	**100**	**358**	**100**	**403**	**100**

According to Table 1, the sample group examined in the thesis is predominantly teachers. Therefore, 68.5% of the theses addressing the subject of "organizational commitment" in education are studies examining the organizational commitment status of teachers. This situation is similar in master's degree (68.4%) and doctoral degree (68.9%) studies. In addition, it was determined that 92 theses (22.8%) were studies examining the effect of school principals' attitudes on teachers' organizational commitment. The weight of master's theses addressing this sample group (23.2%) is higher than doctoral dissertations (20%). On the contrary, doctoral dissertations addressing academics (6.7%) are proportionally higher than master's theses (4.2%). In addition, there are no doctoral dissertations addressing university students or inspectors.

The findings regarding the answer to the fourth sub-problem, "What are the fields of study of the theses?" are given in Table 2.

Table 2. Fields of Study of Theses

Working Fields	Doctoral Dissertations		Master's Thesis		Grand Total	
	f	%	f	%	f	%
Primary and Secondary Schools	27	60,0	163	45,5	190	47,1
Primary Schools	7	15,6	88	24,6	95	23,6
High Schools	6	13,3	40	11,2	46	11,4
Universities	3	6,7	16	4,5	19	4,7
Secondary Schools	1	2,2	13	3,6	14	3,5
Vocational High Schools			11	3,1	11	2,7
Preschool Education Institutions			10	2,8	10	2,5
Private Education Institutions			10	2,8	10	2,5
Private Schools			6	1,7	6	1,5
Ministry of National Education	1	2,2	1	0,3	2	0,5
Grand Total	**45**	**100**	**358**	**100**	**403**	**100,0**

According to Table 2, studies examining employees' organizational commitment in primary and secondary education institutions are dominant at 47.1%. The study fields where the research is conducted show a proportionally balanced distribution according to doctoral and master's theses. However, it is striking that no doctoral dissertations have been conducted in vocational high schools, preschool education institutions, or private schools.

The findings regarding the answer to the question of the fifth sub-problem, "What are the methods discussed in the theses?" are given in Table 3.

Table 3: Methods Considered in Theses

Methods	Doctoral Dissertations		Master's Thesis		Grand Total	
	f	%	f	%	f	%
Relational Scanning	42	93,3	322	89,9	364	90,3
Case Study	1	2,2	27	7,5	28	6,9
Relational Scanning (Mediation Role)	2	4,4	6	1,7	8	2,0
Meta-analysis		0,0	2	0,6	2	0,5
Scale Development		0,0	1	0,3	1	0,2
Grand Total	45	100	358	100	403	100,0

Table 3 shows the methods used in these. Accordingly, it is seen that 90.3% of the studies were designed as relational screening, that is, studies examining the effect of another independent variable on organizational commitment. It was determined that only 6.9% of the theses were case studies, that is, studies investigating how the organizational commitment status of the sample group in question changes according to various demographic characteristics. In 8 theses completed using another relational screening method, the mediating role of a third variable in the relational situation between two variables was examined. Table 3 shows that 372 theses use the relational screening method and the mediating role. This number corresponds to a rate of 92%, which shows that the relational screening method was preferred in almost all the theses. In addition, no doctoral study has used meta-analysis and scale development methods.

The findings regarding the answer to the question "What are the main factors affecting organizational commitment in theses?" addressed in the sixth sub-problem are given in Table 4. As seen in Table 3, only 375 theses of relational screening type were considered.

Table 4: Main Factors Affecting Organizational Commitment

Affecting Factors	Doctoral Dissertations		Master's Thesis		Grand Total	
	f	%	f	%	f	%
Organizational Climate	16	36,4	126	38,1	142	37,9
Individual Factors	11	25,0	115	34,7	126	33,6
Manager	17	38,6	90	27,2	107	28,5
Grand Total	44	100	331	100	375	100

The main factors affecting "organizational commitment" are classified as "organizational climate," "individual factors," and "manager" within the framework of the literature. Accordingly, the main factors affecting organizational commitment are distributed evenly in Table 4.

The findings regarding the answer to the question "What are the concepts examined about organizational commitment in theses?" addressed in the seventh sub-problem are given in Table 5, Table 6, and Table 7.

The concepts included under the classification of "organizational climate," which is one of the main factors affecting "organizational commitment" in theses, are shown in Table 5.

Table 5: Concepts in the "Organizational Climate" class

Organizational Climate	mod	f

Mobbing	19	19
Organizational Justice	14	14
Organizational Cynicism	12	12
Organizational Silence	11	11
Organizational Culture	8	8
Work-Life Quality, Organizational Support	7	14
Organizational Trust	5	5
Organizational Health, Participation in Decision Making	4	8
Organizational Alienation, Organizational Citizenship, Organizational Identity, Organizational Happiness	3	12
Effective School, Career Management, Learning Organization, Organizational Synergy, Rotation	2	10
Organizational Politics, Job Security, Schools' Openness to Change, Physical Conditions, Job Difficulties, Organizational Innovation Management, Space Arrangements, Professionalization, Schools' Innovativeness, Organizational Structure, Organizational Opposition, Work Integration, Organizational Identification, Organizational Ethics, Corporate Reputation, Organizational Power Sources, Working Styles, Inclusive Education, Organizational Stress, Organizational Internal Image, School's Architectural and Historical Features, Organizational Hypocrisy, In-Service Education, Working Time, Social Support Levels, Structural Empowerment, Organizational Forgiveness, Bureaucratization, Organizational Value Perceptions	1	32
Total		142

According to Table 5, one of the most important variables affecting organizational commitment in theses and included under the classification of "organizational climate" is "mobbing" since the concept of mobbing was addressed in 19 theses. The frequency of concepts such as Organizational Justice, Organizational Cynicism, and Organizational Silence is also striking. In addition, concepts such as Organizational Politics, Job Security, Openness of Schools to Change, Physical Conditions, Job Difficulties, Organizational Innovation Management, Space Arrangements, Professionalization, Innovation of Schools, Organizational Structure, Organizational Opposition, Integration with Work, Organizational Identification, Organizational Ethics, Corporate Reputation, Organizational Power Sources, Working Styles, Inclusive Education, Organizational Stress, Organizational Internal Image, Architectural and Historical Features of School, Organizational Hypocrisy, In-Service Training, Working Time, Social Support Levels, Structural Empowerment, Organizational Forgiveness, Bureaucratization, Organizational Value Perceptions have been addressed in only one thesis each.

Table 6: Concepts in the "Individual Factors" class

Individual Factors	mod	f
Job Satisfaction	33	33
Burnout	16	16
Motivation	7	7
Emotional Intelligence, Personality Traits, Positive Psychological Capital	4	12
Procrastination, Success, Psychological Contract, Democratic Attitude, Resistance to Change	3	15
Conflict Styles, Decision Making, Psychological Empowerment, Communication Skills, Attitudes Towards Distance Education	2	10

Anger Level, Emotion Management Competencies, Procrastination, Self-Esteem, Teamwork Perceptions, Job Performance, Autonomy, Involuntary Presence at Work, Psychological Well-Being, Entrepreneurship, Status, Emotional Labor Behaviors, Positive Psychological Capital, Identity, Prejudices, Creativity, Self-Efficacy Beliefs, Moral Value, Image, Crisis Management Skills, Psychological Capital, Loneliness, Classroom Management Skills, Values, Trait Anxiety, Counterproductive Behavior, Informal Communication, Attitudes Towards Refugee Students, Professional Identity, Education Belief, Whistleblowing, Spirituality, Collective Efficacy	1	33
Total		126

According to Table 6, the most critical variable examined about organizational commitment under the classification of "individual factors" is "job satisfaction," included in 33 theses. The concept of "burnout," the subject of 16 theses, comes second. The concepts such as Anger Level, Emotion Management Competencies, Procrastination, Self-Esteem, Teamwork Perceptions, Job Performance, Autonomy, Involuntary Existence at Work, Psychological Well-Being, Entrepreneurship, Status, Emotional Labor Behaviors, Positive Psychological Capital, Identity, Prejudices, Creativity, Self-Efficacy Beliefs, Moral Value, Image, Crisis Management Skills, Psychological Capital, Loneliness, Classroom Management Skills, Values, Trait Anxiety, Counterproductive Behavior, Informal Communication, Attitudes Towards Refugee Students, Professional Identity, Believing in Education, Whistleblowing, Spirituality, Collective Efficacy were included in only one thesis.

Table 7: Concepts in the "Individual Factors" class

Managers	mod	f
Leadership Styles	63	63
Favoritism, Types of Power	5	10
Management of Differences	4	4
Performance Management	3	3
Humor Styles, Empowerment, Power Distance, Human Resources Management, Trust in Leader	2	10
Career Management, Talent Management Perceptions, Transparency Practices, Accountability Practices, Managerial Discourses, Managerial Strength, Strategic Human Resources Management, Managerial Competence, Innovative Management, Influence Tactics, Participation in Decision Making, School Principal	1	17
Total		107

. According to Table 7, the most critical variable examined together with organizational commitment under the classification of "manager" is the concept of "Leadership Styles," which is included in 63 theses (approximately 58%). It has been determined that variables such as Favoritism, Types of Power, Management of Differences, Performance Management, Humor Styles, Empowerment, Power Distance, Human Resources Management, Trust in Leader, Career Management, Perceptions of Talent Management, Transparency Practices, Accountability Practices, Managerial Discourses, Managerial Strength, Strategic Human Resources Management, Managerial Competence, Innovative Management, Influence Tactics, Participation in Decision Making, School Principal are included in the theses once or twice.

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

In this study, which examines in depth the theses that deal with the subject of 'organizational commitment' in the field of education, a total of 403 studies were examined. The first theses on the subject were completed in 2004, and the number of theses has generally been on the rise since that year. When the number of completed master's theses on the subject is taken into consideration, it is seen that foundation universities are at the forefront. In contrast, doctoral dissertations completed in foundation universities are almost nonexistent. Therefore, it can be concluded that doctoral dissertations, which offer the opportunity for in-depth study, should be conducted more, especially in foundation universities.

In most of these, teachers and school principals were chosen as the sample group. Based on this, communication between administrators and teachers is an important research topic for studies examining organizational commitment in education. On the other hand, the fact that there are fewer theses with academics, university students, and public employees such as inspectors or education experts working at other levels of the field of education can give ideas to those who write theses on this subject.

Primary and secondary schools are preferred as the study areas in many theses. Here again, the studies conducted in primary schools are more striking. It has been revealed that the studies are conducted at least in vocational high schools, preschool education institutions, and private education institutions. In addition, the absence of any doctoral studies based on these institutions can be noted as a valuable finding. This situation can also be evaluated as an essential result for master's and doctoral students who want to research this subject.

Almost all the theses are studies designed in the form of relational screening, that is, examining the effect of another independent variable on organizational commitment. Theses and case studies constitute a small part of the research, which are also accepted as a relational screening method and examine the mediating role of a third variable in the relational situation between two variables. However, theses in which meta-analysis and scale development methods are preferred are almost nonexistent.

The use of independent variables discussed in theses is essential in indicating the areas covered by the research and ensuring that other researchers understand the importance and contributions of the thesis. Therefore, knowing how frequently variables affecting organizational commitment in education are used in theses is necessary for those who want to conduct studies in similar fields. Therefore, when the literature is also taken into consideration, the main factors affecting organizational commitment discussed in these are classified as "organizational climate," "individual factors," and "manager." Accordingly, it can be said that these factors are distributed evenly in both master's and doctoral dissertations. One of the most important variables affecting organizational commitment in theses and included under the "organizational climate" classification is "mobbing." In addition, the frequency of concepts such as organizational justice, organizational cynicism, and organizational silence is also striking in theses. It is seen that the most critical variables examined together with organizational commitment under the "individual factors" classification are the concepts of "job satisfaction" and "burnout." The most crucial variable examined about organizational commitment under the "Manager" classification is "Leadership Styles".

Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Ethics Committee Approval Information

This study does not require approval from the ethics committee.

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