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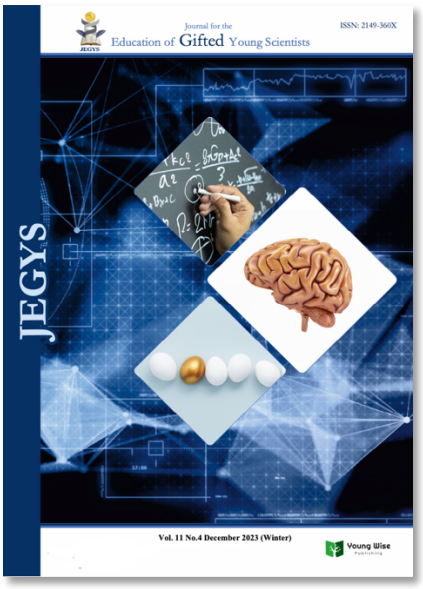

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Research Article

Class size and its effects on the education relationship of trust, understanding and authority: A South African perspective[1]

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Abstract

Quality teaching and learning success depends on the educational relationship between the teacher and the learner. Van Rensburg and Landman agree that the education relationship has its basis in the mutual relationship of trust, understanding and authority between the teachers and the learners. The class size influences the educational relationship between teachers and learners of trust, understanding and authority. In recent years, learner enrolment has rapidly grown in all South African public schools. The increased class size challenged teachers to form authentic mutual relationships of trust, understanding and authority. This study aimed to investigate the effects of large class size on the relationship of trust, understanding and authority in primary schools in the lower South Coast of Durban – Port Shepstone region. The researcher used a quantitative descriptive study which included 150 primary school teachers. These teachers completed a Likert Scale questionnaire on the effects of class size (teacher-learner ratio) on the relationship of trust, understanding and authority. Data was analysed using descriptive analysis through percentages and averages. The findings revealed that the large classes negatively impacted on the education relationship. Teachers found it difficult to understand their learner's needs and could not support them. Furthermore, there needed to be more trust between teachers and learners since learners were seen as strangers to teachers. Moreover, teachers needed help to exercise authority to discipline learners. The study recommended that the Department of Education revisit its teacher-learner ratio guidelines; provide appropriate training and development for teachers to manage large class sizes.

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Introduction

There has been much debate in different circles and forums regarding class size and its effect on quality teaching and learning. In their seminal work, Van Rensburg and Landman (1998) argue that the relationship of trust, understanding and authority is necessary for quality teaching and learning and education. Kohler (2020) states that class size impacts teaching and learning. Class size means the number of learners or students attending a class regularly and who are on the attendance register to receive instructions in a given course or classroom managed by a single teacher (Ayeni & Olowe, 2016). This class is managed by a qualified instructor (teacher) for a given academic period or year. Blatchford and Russel (2016) state that class size is a highly debated topic. There are intense discussions during teacher and class allocation at

[1] A part of the study was presented as an oral presentation at the 3rd International Congress on Gifted Youth and Sustainability of Education (ICGYSE), Turkiye (Turkiye, 2022).

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the school level, which they (teachers) believe affects learner performance. According to Laitsch, Nguyen and Younhusband (2021), school class sizes have been subject to intense scrutiny and debate for many years. It has been argued that large classes pose multiple challenges to teachers compared to smaller classes. Some studies have argued that small class sizes are fiscally unattainable with the current educational funding level (Wadesango,2021; Wilsman, 2013). Howell, West and Peterson (2007) found that 77 per cent of Americans indicated that decreasing class size is a better resource than increasing teachers' salaries. For these reasons, this study explores the effects of class size (teacher-learner ratio) on the education relationship of trust, understanding and authority.

According to BusinessTech (2018), the Department of Basic Education [DBE] stated that the national average teacher-learner ratio for government schools was one teacher to every 35.2 learners. Despite this statement, Zenda (2019) found that there has been a steady increase in learner enrolment in most public schools. This number peaked at 1:59. According to Nkosi (2022), he found that there were 74 learners per classroom in a Gauteng school. In an interview with parents, they (parents) indicated that teachers cannot get to know and understand the educational needs of their learners. As a means of protest, two schools in Gauteng were shut down by parents due to the large number of learners in the classroom.

For this study, the terms class size and teacher-learner ratio will be used interchangeably since both these terms mean the same within South Africa.

Education relationship of trust, understanding and authority

A relationship is the dynamic, interactive, truly human stand or alignment with another person or persons, whereby bipolar association or interaction is established and mutual influence is realised in the education situation (Brady, 2011). The researcher opines that the success of any relationship depends on the people involved in that relationship. An education relationship or association between the teacher and the learner is a specific relationship whereby an adult (teacher) leads a not-yet adult (learner) to attain responsible adulthood and contribute to the country as a responsible citizen (Van Rensburg & Landman, 1988).

In the education situation, the teacher does not only initiate a relationship of trust but also understanding and authority (Eloff, 2011). To ensure mutual trust, understanding and authority, the teacher must know something about the learner's character, attitude, sex, age, physique, cultural background, family life, scholastic and intellectual achievements, dreams and ideals (Van Rensburg & Landman, 1988). In the teaching-learning situation, teachers and learners find themselves in a relationship (da Luz, 2015). Initially, teachers and learners are strangers and a definite 'distance' exists between them. According to OECD (2009), as teachers and learners work towards a better relationship, their knowledge and understanding of each other improve; trust in and respect for one another gradually increase or decrease (Eloff, 2011; Van Rensburg & Landman, 1988); willingness to allow for authoritative guidance grows (Esmaelili et al., 2015). In other words, the initial distance is bridged and they slowly come 'closer together'. By making room for one another, a sound educational atmosphere is constituted. Once an atmosphere of mutual trust, understanding, respect, acceptance and love prevails, invitational learning follows naturally (Venketsamy et al., 2020). Such an atmosphere is, on the one hand, the result of the educative influence and, on the other, the precondition for further educative activities. Therefore, the researcher believes a personal relationship between the teacher and the learner is essential to invitational learning. Purkey and Novak (2015) think that the success of invitational learning in the education environment depends on the teacher's and learners' relationship. Eloff (2011) agrees with Van Rensburg and Landman (1988) that a positive relationship of trust, understanding and authority will promote effective and meaningful invitational learning, while the absence of a good relationship of trust, understanding and authority between teacher and learners will hamper any success of invitational learning in the classroom (Venketsamy et al., 2020).

Relationship of trust between teachers and learners

Trust is frequently used daily in our society and education, especially in the classroom. A student-teacher relationship in the classroom is a positive relationship to gain trust and respect from each other (Coristine et al., 2022), religion, families, business, industry, and government, as well as in friendships and other relationships. Trust is a requisite for a positive, constructive life in the early stages of human development (Vogel-Scibilia et al., 2009). The researcher believes

that for a learner to attain responsible adulthood, learners must learn to explore their life world and come to know it through the support of a trusting teacher.

In the education situation, a special relationship exists between teacher and learner. The situation is unique because it is a loving meeting space where the learner experiences security (Coristine et al., 2022). The safety experienced by the learner gives the learner within the educational space the confidence to ask a trustworthy adult for help. An authentic relationship of trust is realised when the learners entrust themselves to their teachers (Eloff, 2011). Within a relationship of trust, the learner expects acceptance by his teachers as he is, will be, can be, ought to be and must be. Teachers should also respect the learner's learner-likeness and human dignity (Coristine et al., 2022)). The quality of the relationship of trust, or affective guidance, is directly related to the quality of the learner's learning (Niedlick et al. et al., 2021). If adults and learners genuinely know each other, they will gradually grow to trust one another. The relationship of trust is a precondition for an improved knowing of each other. If adults and learners genuinely trust one another, learners will become more willing to obey the authoritative say of teachers and adult norms (Coristine et al., 2022).

Relationship of understanding between teachers and learners

Mutual understanding is a prerequisite for the promotion of invitational learning. Eloff (2011) states that understanding is conceptualised in terms of the teacher's responsibility to fully understand the nature of the learner so that a cooperative teaching and learning situation may be actualised. Invitational learning can only be realised with mutual understanding between the teacher and the learner in an educational situation (Purkey & Novak, 2015). A learner desires to be someone and also needs to and wants to know and understand. To adequately actualise this cognitive directedness (intentionality), the learner relies on the accompaniment or guidance of a trustworthy and understanding teacher (Coristine et al., 2022; Eloff, 2011). According to Garrett (2008), the accompaniment of the learner by the teacher towards increasing knowledge and understanding not only requires that the teacher generally understands the nature of learners and the role of education and their becoming but also the uniqueness and particularity of this learner in his actuality and potentiality. This understanding should also reflect respect for the dignity of the individual learner (Purkey & Novak, 2015).

The relationship of understanding between teachers and learners is alternatively referred to as the relationship of knowing by educationists (Coristine et al., 2022). Wessels (2015) says that knowing somebody does not mean having a complete understanding or concept of that person. Understanding and conception are more comprehensive concepts than knowing and knowledge. It is, therefore, possible for the teacher to 'know' the learner without 'understanding' him (Van Rensburg & Landman, 1988). Purkey and Novak (2015), Oberholzer *et al*. (1990) and Yonge (1990) all agree that the relationship of understanding is a precondition for creating and maintaining the education relation of trust, understanding and authority, which is imperative for invitational learning. To educate the learner, the teacher has to understand the learner well and acquaint himself progressively and more thoroughly with the learner, especially regarding whether and to what extent the learner is educable (Eloff, 2011; Van Rensburg & Landman, 1988). The researcher is of the view that on the other hand, the learner should know who his teacher is and what to expect of him. Based on their mutual understanding, they both establish the educational relationship of understanding which can be initiated from the teacher's side or the learner's. Coristine et al. (2022), Niedlick et al. (2021) and Van Rensburg and Landman (1988) maintain that the learner's acceptance of such accompaniment emanates from his belief and trust in the adult as someone who offers advice and knowledge worth following.

According to Purkey and Novak (1984), the teacher is expected to understand what it is to be a learner, the essence of being and learner and the learner's needs to become a responsible adult. This includes knowledge and understanding of the learner's educability, which depends on his physical abilities, talents, shortcomings, limitations and individuality (Venketsamy et al., 2020). The teacher has to be knowledgeable and well aware of the continuous changes the learner is undergoing in his transition to adulthood. According to the South African Council of Educators (n.d), it is only possible for the teacher to render adequate support and assistance to the learner in each phase of becoming if he understands the different stages of the learner's development.

If teachers do not know their learners, they can never correctly understand them (SACE, n.d). The act of understanding implies action. Soldaat (2019) state that through understanding, teachers and learners constitute each other in their worlds and attach meaning to each other's existence. Interpersonal understanding goes beyond theoretical knowledge and involves imaginative reactions to what others will do. The researcher believes that mutual understanding implies the ability to place oneself in the shoes of another. Teacher and learner supplement their knowledge of one another with a proper understanding of one another if they can see the world from the viewpoint of the other (SACE, n.d). The relationship of understanding also implies that the teacher has to understand what the future holds for the learner and what the aim of education is (Ann Ordu, 2021). This means that the relationship of understanding suggests explorations within the education situation

The relationship of authority between teachers and learners

Arising from the Latin words "auctoritas" and "augere", which mean "power" and "to help", educational authority implies that the teacher conveys the meaning of authority to the learner by telling, setting an example or helping the learner to behave appropriately to ensure successful invitational learning (Van Rensburg, Landman & Bodenstein, 1994). Educational authority is based on the love and affection that the teacher has for the learner (Murati, 2015). Loving authority allows the learner to feel safe and cared for, leading to willing obedience to authority (Purkey & Novak, 2015: Venketsamy et al., 2020)). According to Eloff (2011) and Venketsamy et al. (2020), educationists agree that authority is indispensable for realising successful invitational learning. The researcher believes that in the absence of authority, in one form or another, the education situation cannot be realised and invitational learning will not occur. According to Harsch (Esmaeili et al., 2015), the teacher, as a figure of authority, can change his association with the learner into an educational situation solely on the strength of his authority. This authority is valid, while the learner still needs to have sufficient responsibility and knowledge to decide between what is right and what is wrong, what is acceptable and what is unacceptable.

Esmaeili et al. (2015) believe that before the learner is prepared to contemplate establishing a relationship of authority, he must accept authority and be able to submit to it, which is a prerequisite for meaningful invitational learning. To obey authority, the learner must acknowledge the authority and understand it – therefore, the necessity for the adequate realisation of the relationship of understanding (Egan, 2019; Van Rensburg & Landman, 1988). For the acceptance of educational authority by the learner, a relationship of trust must exist between the teacher and the learner (Esmaeili et al., 2015; Venketsamy et al., 2020). Trust and understanding are imperative for realising the relationship of authority (Coristine et al., 2022; Vogel-Scibilia et al., 2009).

Acceptance of authority by the learner also requires sustained discipline. Egunlusi (2020) state that in education, discipline means the voluntary acceptance of the teacher's authority by the learner. Van Rensburg and Landman (1988) agree that pedagogic authority cannot be imposed on learners but can be acquired or developed through interaction between the teacher and the learner in a spirit of mutual trust, respect and understanding. As a symbol of authority, the teacher has to display certain qualities in his interpersonal relationship or contact with the learner to get him to accept and respect his authority (Egunlusi, 2020; Eloff, 2011). A teacher can only be entrusted with pedagogic authority if he displays a love for the learner, concern for his well-being, and a genuine interest in his progress (Van Rensburg & Landman, 1988). The researcher opines that the teacher and the learner must have mutual trust and understanding before the pedagogic authority can succeed. If the adult knows the learner well enough to impart the norms and values inherent in the societal code of conduct, the progress of pedagogic authority may remain the same. Through respect, the teacher and the learner will accept each other just as they are – as unique persons in their own right. Therefore, the relationship of authority has nothing to do with authoritarianism. The implication here is not that the learner should submit himself unwillingly to the strict and authoritarian power of the teacher. The authority relationship should ***not*** be viewed as a relationship within which learners are compelled, forced and prescribed. For this reason, the researcher emphasises that the etymological origin of the word confirms that authority should not be associated with the exertion of power in the first place. According to Van Rensburg and Landman (1988), in their seminal work state that authority

manifests itself in the sphere of assertion, declarations and statements, figures of authority like judges, umpires, etc. and rules, norms, standards and laws.

Theoretical framework

This paper used the Invitational Education theory of William Purkey and Kim Novak (1984) as a theoretical framework. The researcher chose the Invitational Education theory as a framework because it argues for the importance of all stakeholders working collaboratively to achieve the desired learning outcomes; this study's outcome is the education relationship of trust, understanding and authority between teachers and learners. The researcher believes that theory is relevant to the study because its focuses on the relationship of trust, understanding and authority between the teacher and the learner for successful classroom practice despite the large class size (teacher-learner ratio). Purkey (1999) states that *Invitational education (IE)* is a theory of practice intended to create a total school environment that intentionally commands people in schools to realise their unlimited potential. It addresses the global nature of schools and the relationship between all stakeholders involved in ensuring quality teaching and learning within a conducive learning environment. Smart (2019) states that the main aim of invitational education is to make schooling an exciting, satisfying and enriching experience for everyone involved in the educative process. Invitational education offers guidance and practical means to accomplish its purpose, ensuring quality teaching and learning (Egley, 2003; Purkey, 1999).

Egley (2003) and Smart (2020) state that IE envisages creating an entire school environment that invites everyone to be successful and form meaningful educational relationships to achieve the desired learning outcomes. The purpose of IE is to create a more exciting and enriching experience for all role players in the education process (Purkey & Aspy, 2003) with the intent to grow human potential Smart (2020) agrees that IE is a student-centred approach to the teaching-learning process that attempts to foster a positive and harmonious relationship between the teacher and the learner.

The Invitational Learning Theory outlines five domains prevalent in almost every school environment that contribute to the success or failure of human endeavour. These domains are called 'The five powerful P's' and consist of people, places, policies, programs and processes (Purkey & Novak, 1988). The Powerful P creates an ecosystem in which the individual exists in a relationship with others (Purkey, 1991). Purkey & Novak (2015) use the starfish analogy to illustrate the five powerful Ps. When these are applied with steady and persistent pressure, it is easier to overcome the biggest challenges in a classroom between teachers and learners. Just as a starfish gently and continuously uses each of its arms, in turn, to keep steady pressure on one oyster muscle until it eventually opens. This analogy is relevant in the classroom between the teachers and learners. When teachers face challenging situations in their classroom, they may implement the elements of the five powerful Ps to maintain order and discipline (See Figure 1).

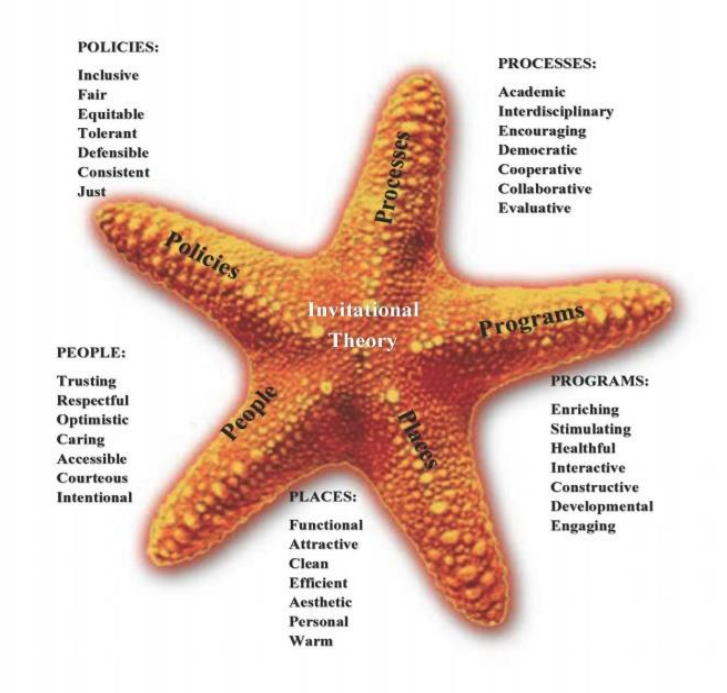

Figure 1. The elements of the 5Ps from invitationaleducation.org

Aim and Problem of Study

This paper aimed to explore the effects of class size on the relationship of trust, understanding and authority in primary schools in the Lower South Coast of Durban – KwaZulu-Natal province in South Africa. The Department of Basic Education [DBE] (1996) mandated, through the South African School's Act of 84 of 1996, that schools should accommodate and give access to schooling to all learners. As a result of this mandate, there has been an influx of learners from rural schools into urban and semi-urban areas. Class- sizes increased exponentially, thus creating a crisis in terms of providing quality education, supporting the individual needs of learners, lack of appropriate infrastructure and resources and classroom management. The teacher-learner ratio from 1:25 in primary schools increased to 1:40 and is still growing. In some schools, the teacher-learner ratio is 1:70; therefore, this study investigated teachers' views regarding the increased class size and its effect on the relationship between trust, understanding and authority.

Method

Research Design

The research followed a quantitative approach (Maree, 2020) using a descriptive and a causal non-experimental survey research design. The rationale behind choosing this design was that it was the most appropriate and suitable; since the research aimed to describe the present situation as it exists (Creswell, 2014). This research used a descriptive and causal non-experimental design to determine the teacher-learner ratio and its effect on invitational teaching and learning.

Participants

To administrate the questionnaire, 150 teachers in primary schools in the Durban South and Port Shepstone regions were randomly selected. Three teachers from 50 schools participated in this study from the Durban South and Port Shepstone regions, resulting in 150 participants. The inclusion criteria were that the teacher had to teach a class with more than 40 learners, the class had to consist of learners from different racial and cultural backgrounds and the teacher had to have a minimum of five years teaching experience. Among the participating teachers, 102 (68 %) were females and 48 (32%) were males. On average, the participants had more than five years of teaching experience.

Data Collection Tools

Interview form

The researcher collected the data using a questionnaire with two sections: biographical data (Section 1) and statements about factors that affect invitational teaching and learning. The questions in section 2 consisted of a 3-point Likert scale regarding the factors that affect invitational teaching and learning (1- agree; 2 – disagree; 3 – uncertain) (Maree, 2020). The questionnaire included 44 closed-type questions. The researcher, together with his supervisor, developed the questionnaire. The questionnaire included 44 closed questions using the Likert Scale, 3 levels which participants had to choose from 'agree, disagree and uncertain'. The questionnaire was subdivided into two sections. Section one dealt with the biographical information of the respondents and consisted of questions 1 to 10. Section two focused on the factors concerning the learners, teachers and the school environment and consisted of 44 closed questions. In this section, respondents were asked to indicate their perceptions of the teacher-learner ratio and invitational learning in three ways: agree, disagree and uncertain.

Pilot Study

To ensure the validity and reliability of the instrument, the researcher conducted a pilot study (Cohen et al., 2018). A pilot study is an abbreviated version of a research project in which the researcher practices or tests the procedures for the subsequent full-scale project (Creswell, 2014; Maree, 2020). For this study, the researcher conducted a pilot run of ten teachers randomly selected from primary schools in the same regions, adhering to the similar criteria mentioned in the sub-section 'participants. The pilot study permitted preliminary questionnaire testing for clear understanding, language clarity, ambiguity and double-bind questions. The pilot study allowed the researcher to rephrase some questions to ensure clarity and avoid misinterpretation. The pilot also indicated to the researcher the time required to complete the

questionnaire. Once all the factors were considered, the research supervisor finalised and approved the questionnaire for distribution. Data collected from the pilot study were not included in the final data analysis.

Data Analysis

Once data was collected, it was captured in a format permitting analysis and interpretation. This involved carefully coding the 150 questionnaires completed by the teachers of primary schools. The coded data were transferred onto a computer spreadsheet using the Quattro Pro 4.0 database statistics computer programme. The coded data was submitted to the Department of Statistics at a South African university and computer analysed using the SAS programme to interpret the results using descriptive statistics. For this study, the researcher opted for both descriptive and presented the data in frequency tables for interpretation.

Ethics

The University of Zululand granted ethics approval to conduct this study as part of a doctoral research study. For ethical purposes, the researcher reached out to each participant with a formal letter of invitation outlining the project and requesting their participation (Denzin, Lincoln. & MacLure, 2017). To administer the questionnaire to teachers of schools in the Durban South and Port Shepstone area, the researcher contacted the relevant circuit inspectors by telephone and received verbal permission from them to conduct the proposed research. The *proviso* was, however, that permission should be obtained firstly from the school's principal before approaching the members of their teachers. Participants who agreed to participate in the study signed the consent form agreeing to participate. They were also informed of voluntary participation and were not obligated to complete the questionnaire. All participants were ensured anonymity and confidentiality of their participation in the study. They were informed that during the reporting phase, pseudonyms would be used.

Results and Discussion

The research aims to gain insight into a situation, phenomenon, community or person. Descriptive research is one of the methods of research used to study a person or persons scientifically in the educational situation (Aggarwal & Ranganathan, 2019). It attempts to describe the situation as it is; thus, there is no intervention on the researcher's part and, therefore, no control. Cohen et al. (2018) state that descriptive studies do not set out to test hypotheses about relationships but want to find the distribution of variables. This study employed nomothetic descriptive research to describe the teacher-learner ratio and its effect on invitational teaching-learning. The researcher was primarily concerned with the nature and degree of existing situations in public primary schools in South Africa in the Lower South Coast of Durban.

Gender table of respondents

Table 1. Frequency distribution according to the gender of respondents

	Gender	Frequency	%
1	Males	48	32,0
2	Females	102	68,0
	Total	150	100

Table 1 shows that 36% more females than males completed the questionnaire. Dlwati (2018) states that female teachers comprise about 70% of the country's workforce. According to Davids and Waghid (2020), several studies have found that females tend to choose teaching professions earlier in their lives than men. Although both men and women tend to choose teaching as a profession for altruistic reasons, such as working with children, males usually choose the profession for motives such as salaries and government benefits and the prestige of the profession (Montecinos & Nielsen, 1997) The researcher believes that possible reasons for this finding might be that females see teaching as an occupation where they can be accessible in the afternoons to attend to their regular chores such as household management and caring for their young children.

Number of learners in the largest class the respondents teach

Table 2. Frequency distribution according to the number of learners in the largest class in which the respondents teach

	Number of learners	Frequency	%
1	10 – 20	3	2,0
2	21 – 30	21	14,0
3	31 – 40	34	23,0
4	41 –50	71	47,0
5	51 – 60	9	6,0
6	61 – 70	7	5,0
7	71 – 80	3	2,0
8	More than 80	2	1,0
	Total	150	100

Most teachers who completed this questionnaire taught classes with more than 40 learners. The data reveals that 71 (47%) teachers indicated that they had a class size of 41-50 learners despite the Minister of Education indicating that they were considering a smaller teacher-learner ratio. Fourteen per cent (14%) of the teachers indicated that they had a class size of more than 51 learners.

Table 3. Frequency distribution according to the respondent's perception of a favourable teacher-learner ratio (class size**)**

	Class-size	Frequency	%
1	10 – 15	3	2,0
2	16 – 20	16	11,0
3	21 – 25	74	49,0
4	26 – 30	32	21,0
5	31 – 35	20	13,0
6	36 – 40	5	4,0
	Total	150	100

Table 3 shows that most teachers, 93 (62%), preferred classes with 25 or fewer learners. The teachers indicated that with a small number of learners, they could provide quality teaching and learning. A small percentage (34%) indicated they could manage a class size of 26 – 35 learners.

Relationship of Trust between teachers and learners

Table 4. Frequency distribution according to the relationship of trust between teachers and learners

Question Number	Agree %	Disagree %	Uncertain %	Total
2.3 Respect for the Teachers	60	84	6	150
	40%	56%	4%	100
2.4 Trust in the teachers	45	81	24	150
	30%	54%	16%	100
2.5 Feeling of safety (security) in the classroom	92	39	17	150
	61%	27%	12%	100
2.8 The teachers' trust in learners' potential	93	41	16	150
	62%	27%	11%	100
2.10 The creation of a warm atmosphere in class	66	56	28	150
	44%	37%	19%	100
2.11 Individual assistance to learners	98	42	10	150
	65%	28%	7%	100
2.14 The class size influences learning	101	28	21	150
	67%	19%	14%	100
Average	79	53.5	17.5	150
	53	35	12	100

According to the averages in Table 4, more than half of the respondents (57%) agreed that an unfavourable teacher-learner ratio (class size) affects the relationship of trust. It is globally agreed that the trust between teachers and learners plays a significant role in academic education at school.

In statement 2.3, more than half, 84 (56%) participants, disagreed that large class size affects respect between teachers and learners. According to the DBE (2011) and Gerges (2022), teachers should plan for their teaching and learning effectively for quality teaching and learning. Meador (2019) states that effective planning and positive attitudes towards

their subject will earn the respect of learners. He further states that developing positive, respectful relationships with learners is a significant element in earning the respect of learners. The researcher opines that learners tend to become disrespectful when they are aware that the teachers have not planned their lessons and have come to class unprepared.

According to statement 2.4 regarding the class size and 'respect for teachers, 84 (56%) disagreed that the class size affects the relationship of trust between teachers and learners. Platz (2021) based her view on two assumptions: trust between the teacher and the learner is essentially about them being in a trust relationship and secondly, the role of trust in the learner's need to excel academically. Therefore, the researcher believes learners trust the teacher because they need academic support to excel in school. Furthermore, Eloff (2011), Platz (2021) and Van Rensburg and Landman (1988) state that when a learner trust, their teacher are optimistic that the teacher will act in a certain way even though the learner does not know whether the teacher will do so.

Although less than half of the respondents agreed that trust 60 (40%) and respect 45 (30%) for teachers would be affected by a large class size, the findings by Eloff (2011), Meador (2019) and Platz (2021) agree that trust and respect can be earned within a large class. According to SACE (n.d), teachers with responsible professional conduct can still be trusted in large classes.

For successful invitational teaching and learning, Purkey and Novak (2015) believe that all learners should experience a feeling of safety in their classroom. In 2.5 on the statement of safety in a large class, 92 (61%) respondents indicated that safety is an issue for both learners and teachers. Due to the large class size, teachers are challenged with managing discipline in their classrooms and often experience passive aggression from their learners (Venketsamy et al., 2023).

Trust is an essential requirement for quality teaching and learning. Purkey and Novak (2015) agree that a relationship of trust is a prerequisite for quality invitational teaching and learning. This study found that over 61% of the participants agreed that large class size makes it difficult for teachers to trust in the learner's potential. According to Wilsman (2013), large class sizes pose many challenges and cheating is one of many. Since teachers cannot control or restrict cheating in large classes, they cannot trust the learner's potential, as some teachers, according to Stauffer (2022), believe that among learners, academic dishonesty exists and that there is minimal a teacher can do.

In item 2.10, forty-four per cent of the participants agreed that a large class size creates a warm atmosphere. Purkey and Novak (1984) and Smart (2020) agree that every teacher should maintain a warm conducive learning environment in their classrooms. Despite this view by these authors, the findings in this study showed that class size has an effect. Teachers could not build trust with their learners, a prerequisite for invitational teaching and learning. In item 2.3, sixty (60), 40% of the participants agreed that large class size affects teacher respect. This study showed that in a large class, the respect for the teacher is broken down since learners do not know and understand their teachers.

Another challenge experienced by most participants in this study is providing individual support to learners (item 2.11), and the class size influences learning (2.14). In item 2.11, Ninety-eight (98) 65% of the participants agreed that large class size makes it very challenging for teachers to support individual learners. Kohler (2020) agrees that a small class size is necessary to achieve learning outcomes. Within a small class, the teacher can appropriately support learners and influence learning (2.14). 67% of the participants indicated that it was very challenging for them to influence learning in their large classrooms. They could not manage disciple among learners; they needed to know their learners and the learner's individual needs, thus making it difficult for them to plan their teaching and learning. Smart (2020) found that in smaller foundation phase classes, teachers could support and engage with all learners to participate in their classroom activities.

Relationship of Understanding between teachers and learners

Table 5. Frequency distribution according to the relationship of understanding between teachers and learners

Question Number	Agree	Disagree	Uncertain	Total
	%	%	%	
2.7 The teachers' understanding of individual learner's problems	121 81%	27 18%	2 1%	150 100
2.12 An atmosphere conducive to learning	126 84%	20 13%	4 3%	150 100
3.8 Understanding of learners as unique beings	116 77,3%	29 19,3%	5 4%	150 100
3.14 Understanding learner's development	107 71%	36 24%	7 5%	150 100
4.8 The teachers' understanding of different cultural issues	107 71%	35 23%	8 6%	150 100

4.10 Respect for learners' different religious beliefs	97	43	10	150
	64%	29%	7%	100
Average	112	32	6	150
	75	21	4	100

The relationship of understanding between the teacher and the learner is an essential relationship within the education structure (Van Rensburg & Landman, 1988). In their Invitational Education theory, Purkey and Novak (1984) and Purkey and Novak (2015) emphasise the importance of mutual understanding between the teacher and the learner to promote invitational teaching and learning. The findings in this study revealed that 112 (75%) of the participants agreed that large class size has a negative effect on the mutual understanding between the teacher and the learner.

According to the statement in item 2.7 (The teachers' understanding of individual learners' problems), a very high percentage (81%) of the participants agreed that large class size makes it very challenging for teachers to understand individual learners' problems. Items 3.8 and 3.14 support items 2.7. This study found that 77.3% (item 3.8) and 71% (item 3.14) agreed that they did not know their learner's uniqueness and the developmental needs of individual learners. Wadesango (2021) and Wilsman (2013) agreed that large class sizes pose several challenges to teachers and mutual understanding between teachers and learners is one such challenge. Furthermore, teachers cannot support learners (see 2.11) since they do not know their learners. In a large class, it is challenging for teachers to plan for individual teaching and learning (Wadesango, 2021). Furthermore, teachers cannot create a conducive teaching and learning atmosphere within a large class. This study revealed that 84% of the participants agreed that it was a daunting experience to create a positive learning climate in their classes.

As a result of the large class size, most respondents 71% agreed that they needed more understanding of the learner's cultural issues. Teachers found it difficult to understand their learners since they did not get to know each learner personally. Fortes (2010) agrees that getting to know and understand learners' diversity, religious values, and belief systems within a large class is challenging. This study found that 64% of the participants agreed that they did not understand the religious beliefs of their learners. Young (2023) maintains that teachers must remember that learners are complex individuals with diverse experiences, emotions and identities that they bring into the learning environment. It is vital that teachers take cognizance of these issues; however, this study found that the large class size that teacher teach make it very challenging for them to understand the complex nature of their learners.

Relationship of Authority between teachers and learners

Table 6. Frequency distribution according to the relationship of authority between teachers and learners

Question Number	**Agree**	**Disagree**	**Uncertain**	**Total**
	%	**%**	**%**	
2.1 Effective discipline in the class	126	24	0	150
	84%	16%	0%	100
2.2 Learners' obedience to the teacher's authority	99	34	17	150
	66%	23%	11%	100
3.5 The exercising of autocratic authority	57	52	41	150
	38%	35%	27%	100
3.11 Freedom is given to learners in the class	82	60	8	150
	55%	40%	5%	100
3.13 The exercising of democratic authority	72	50	28	150
	48%	33%	19%	100
4.14 Implementation of Curriculum	112	29	9	150
	75%	19%	6%	100
Average	91	42	17	150
	61	28	11	100

The mutual education relationship of authority should not be misunderstood with a legal explanation of authority and the coercion of power. In an education authority relationship, the learner is not compelled, forced or coerced to prescribed norms (Van Rensburg & Landman, 1988). Eloff (2011) and Murati (2015) believe that the education authority relationship is based on mutual respect and understanding between the teacher and the learner. In this study, an average of 91 (61%) of the participants agreed that large class size affects the education relationship of authority

between teachers and learners. This view concurs with Fortes (2010) and (Wadesango, 2021), who found that a large class size poses several challenges to teachers, especially in discipline and classroom management.

According to item 2.1 regarding effective discipline in the class, a very high percentage (84%) of the participants found it difficult to discipline learners in their large classes. Sixty-six (66%) per cent in item 2.2 indicated that learners were disobedient to their teachers and 72% in item 3.13 agreed that it was very challenging for them to exercise democratic authority in their classes. According to Purkey and Novak (2015), quality invitational teaching and learning are only possible when there is mutual collaboration between the teacher and learner. As a result of the large class size (teacher-learner ratio), participants found it difficult to exercise authority in their classes. Since the authority relationship is necessary for quality invitational teaching and learning, Egan (2019) and Van Rensburg and Landman (1988) agree that learners need to acknowledge and obey the teacher's authority so that the teacher can support them to achieve their academic goals. Furthermore, Egunlusi (2020) believes that the acceptance of authority by the learner also requires sustained discipline. The researcher believes that through discipline, learners realise the necessity for order in their world and that some behaviours are unacceptable whilst others are praised.

Conclusion

The constructs of 'trust', 'understanding' and 'authority' have been explored extensively in education. For quality invitational teaching and learning, there must be a mutual relationship of trust, understanding and authority between the teacher and the learner, according to Van Rensburg and Landman (1988), Prukey and Novak (2015). Learner support from an adult (teacher) and mutual acceptance and expectations are integral to an educational trust relationship. This is supported by most participants in this study who agreed that with mutual trust, understanding and authority, providing appropriate support to learners would be easier. Blatchford and Russel (2016) also agree that there must be a willingness and acceptance by teachers and learners to provide and receive a quality education. Venketsamy, Sing and Smart (2020) also found in their study that mutual. Understanding is necessary between teachers and learners for invitational education to take place. Only if these relationships are built on mutual acceptance, Van Rensburg and Landman (1988) agree that an authority relationship can be established between the learner and the teacher. In this study, the researcher found that due to the increased class size in primary schools, it has become a significant challenge for teachers to build authentic relationships of trust, understanding and authority in their classrooms. This view concurs with Brady (2011) regarding values and relationships in education.

Furthermore, this study found that the large class size has impacted invitational teaching and learning. Teachers encountered several barriers to developing a mutual relationship of trust, understanding and authority in their large classes as they believed the learners were 'strangers' to them. This study found that in large classes, learners were anonymous to the teacher and classroom management became a significant challenge.

Recommendations

Emanating from the findings of this study, the researcher recommends the following:

- The DBE should consider the class size and its effect on quality teaching and learning. To ensure successful learning outcomes, the guidelines on the teacher-learner ratio should be revisited. Although the DBE has recommended 1:40 learners in primary schools, school principals do not meet this requirement. Schools should be appropriately monitored and those principals who are filling their classes should be disciplined.
- Teachers of large classes should be given special training programmes on managing teaching and learning in their large classes. Teachers with the necessary skills in extensive classroom management can achieve appropriate learning outcomes.
- The researcher recommends maintaining class size at 1:30 learners and below to ensure a mutual educational relationship of trust, understanding and authority. In smaller class sizes, teachers will be able to know and understand their learners' needs, backgrounds, norms and values. This would help teachers to plan their teaching and learning programmes to accommodate all learners.

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Research Article

Investigation of burnout levels of special education teachers [1]

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Abstract

The aim of this study was to investigate burnout levels of teachers working in special education schools according to different variables. 127 teachers from Üsküdar, Kadıköy, Ataşehir and Beykoz districts of the Anatolian side of Istanbul participated to the study. In this survey research the data was collected with the Maslach Burnout Scale. Personal information form for demographical data was also given to the participants. The statistical analyzes of the data was conducted in SPSS software package and the burnout levels of the participants were determined. According to the findings, the burnout levels of the teachers did not differ significantly in terms of gender and seniority variables. However, there is a significant difference in the subscale of emotional exhaustion among teachers with undergraduate and graduate degrees ($t = -2{,}036$, $p < .05$). As the level of education increases, the levels of emotional exhaustion of special education teachers increase. Additionally, when the working time in same school was taken into consideration, it was determined that teachers were statistically differentiated in sub-dimensions of emotional exhaustion ($F = 4{,}781$, $p < .05$) and depersonalization ($F = 6{,}961$, $p < .05$).

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Introduction

The impact of teachers in educational institutions on the quality of education is an important factor for the level of development of a country. We can describe teachers as the cornerstone of education, as they have important duties such as increasing students' motivation, contributing to the learning process and supporting their personal development. Although there are many factors that affect the quality of education, the role of teachers is the most important. Teachers' morale, motivation and efficiency are of great importance in the healthy operation of the education system. Efficiency in educational institutions is also achieved through people. People's emotions, enthusiasm, excitement and morale are very important in creating this productivity. It is very difficult to expect contribution to the workplace from people who are angry, resentful, tired and fed up with life (From Alıç, 1996, cited in Karaköse and Kocabaş, 2006). Everyone wants to be liked and appreciated as a result of the work they do. Being liked and appreciated also helps people develop their self-esteem and confidence (Bentley, 1998 as cited in Yavuz and Karadeniz, 2009: 508). The teaching profession has recently attracted attention regarding the loss of professional value. The reasons for this may include changes in the education system, student behavior problems, and new policies. However, it remains one of the preferred professions (Seferoğlu, Yıldız & Yücel, 2014: 2).

One of the factors that reduce teachers' productivity or performance is burnout. Burnout is a syndrome characterized by emotional exhaustion, depersonalization, and decreased personal accomplishment (Maslach and Jackson, 1981).

[1] This study was produced from Cevriye ŞEN's project assignment of the same name prepared in the non-thesis master's program of Sabahattin Zaim University, Institute of Social Sciences, Department of Educational Management, completed under the supervision of Dr.Mustafa ÖZGENEL.

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Burnout is more common in teaching than in other professions. The reason for this is that teaching is a profession that requires effort beyond the defined duties, is based on constant communication with people, and eventually leads to burnout. Therefore, it can be said that teaching is one of the at-risk professions with a high probability of experiencing burnout (Baltaş & Baltaş, 1993; Akt, Seferoğlu, Yıldız, & Yücel, 2014). According to Dorman (2003; cited in Seferoğlu, Yıldız, Yücel, 2014), the biggest harm burnout causes to teachers is the possibility of preventing them from continuing their jobs. When teachers begin to experience burnout, negative emotions also arise. Afterwards, they begin to have communication problems with their students and colleagues. As a result, teachers' private lives outside of their profession may be negatively affected and they may experience various problems, especially psychological ones. Burnout is just like an infectious disease; when it is seen in one teacher at a school, it soon begins to be seen in other teachers. Therefore, when the situation is noticed, a solution should be sought immediately (Seferoğlu, Yıldız and Yücel, 2014). High motivation of teachers reflects positively on their performance, while high burnout reflects negatively on their performance. Many factors, both internal and external to the organization, are effective on teacher motivation and burnout. However, it is thought that the communication between school administrators and teachers is an important intra-organizational variable that affects teacher motivation and burnout (Çelik, 2013).

Problem of Study

Teacher burnout is a situation that needs to be focused and studied in order to ensure quality in education and build it on solid foundations. It is considered important to examine the burnout levels of special education teachers, especially those working with disadvantaged students, according to their demographic characteristics. This study aimed to examine the burnout levels of special education teachers according to different demographic variables.

This research was conducted to examine the burnout levels of special education teachers according to their demographic characteristics. The research sought answers to the following questions.

Subproblems;

- Is there a difference in the burnout levels of special education teachers according to gender?
- Is there a difference in the burnout levels of special education teachers according to their years of work in the profession?
- Is there a difference in the burnout levels of special education teachers according to their educational status?
- Is there a difference in the burnout levels of special education teachers according to the years of work at the school?

Method

Research Model

In this research, the relational survey model, one of the quantitative research methods, was used. Relational screening model is a research model that aims to determine the existence and/or degree of co-variation between two or more variables (Karasar, 2009).

Sample

In this research, they were randomly selected among the special education teachers working in special education schools affiliated with the Ministry of National Education in the districts of Üsküdar, Kadıköy, Ataşehir and Beykoz on the Anatolian side of Istanbul. A total of 127 teachers participated in the study. The characteristics of the study group are shown in Table 1.

Table 1. Demographic characteristics of participants

Variables		N	%
Gender			
	Female	88	69,3
	Male	39	30,7
Edeucation level			
	Undergraduate education	68	53,5
	Graduate education	59	46,5
Seniority			
	1-5 years	16	12,6
	6-10 years	26	20,5
	11-15 years	28	22,0
	16-20 years	27	21,3
	21+yeasrs	30	23,6
Seniority in the school			
	1-5 years	44	34,6
	6-10 years	24	18,9
	11-15 years	22	17,3
	16-20 years	20	15,7
	21+yeasrs	17	13,4
Total		127	100

Data Collection Tools

Maslach Burnout Scale and Personal Information Form were used to collect data in this study.

Maslach Burnout Scale

Maslach and Jackson (1981) developed the original Maslach Burnout Scale, and Ergin (1992) translated it into Turkish and conducted validity and reliability studies. The scale consists of 22 items; There are nine items in the Emotional Exhaustion dimension, five items in the Depersonalization dimension, and eight items in the Feeling of Personal Failure dimension. The scale is a five-point Likert type and the answers are given as "Never, Very rarely, Sometimes, Mostly and Always". The Emotional Exhaustion and Depersonalization dimensions consist of positive items, while the Feeling of Personal Failure dimension consists of negative items. A score cannot be obtained from the sum of the items of the scale, but the scores of the sub-dimensions are evaluated separately (Ergin, 1992, cited in Erdemoğlu-Şahin, 2007).

Personal Information Form

The personal information form developed by the researcher includes four questions to determine the teachers' gender, educational background, professional seniority and working hours at their school.

Data Analysis

SPSS program was used to analyze the data. In statistical analysis, the significance level was accepted as .05. In the study, firstly, the frequency and percentage distributions of gender, education level, professional seniority and working hours at school were examined. Independent samples t-test was used to determine whether teachers' burnout levels varied according to their gender and educational background. One-way analysis of variance test was used to determine whether burnout levels varied according to professional seniority and length of time working at school.

Results

This section includes the findings of the analyzes conducted to determine whether the burnout levels of special education teachers differ according to their gender, education level, length of service and time spent in school.

The findings of the t-test in independent groups conducted to determine whether the burnout levels of special education teachers differ according to gender are shown in Table 2.

Tablo 2 . t-Test results of participants' burnout levels according to gender

Dimensions		**N**	$\bar{X}$	**ss**	**t**	**p**
Personal	Female	88	1,69	,76	-1,256	,211
Failure	Male	39	1,87	,68		
Emotional	Female	88	1,58	,81	-1,773	,079
Exhaustion	Male	39	1,84	,59		
Depersonalization	Female	88	1,62	,98	-,019	,985
	Male	39	1,63	,81		

According to Table 2, there is no significant difference between male and female teachers in terms of the average scores obtained from the personal failure, emotional exhaustion and depersonalization dimensions of the Maslach Burnout Scale (p>.05). It can be said that gender is not a variable affecting burnout in special education teachers.

The findings of the t-test in independent groups, which was conducted to determine the differentiation of special education teachers' burnout levels according to the education variable, are shown in Table 3.

Table 3. t-Test results of participants' burnout levels according to education level

Dimensions		**N**	$\bar{X}$	**ss**	**t**	**p**
Personal	Graduated	68	1,65	,72	-1,629	,106
Failure	Postgraduate	59	1,86	,75		
Emotional Exhaustion	Graduated	68	1,54	,80	-2,036	,044
	Postgraduate	59	1,81	,68		
Depersonalization	Graduated	68	1,53	,99	-1,170	,244
	Postgraduate	59	1,73	,84		

According to Table 3, there is no significant difference between male and female teachers in terms of the average scores they obtained from the personal failure and depersonalization dimensions of the Maslach Burnout Scale (p>.05). However, there is a significant difference between undergraduate and graduate teachers in terms of the average score they received from the emotional exhaustion dimension (p <.05). Emotional exhaustion levels of postgraduate graduates are higher than undergraduate graduates.

The results of the one-way ANOVA test, which was conducted to determine the differentiation of burnout levels of special education teachers according to their length of service, are given in Table 4.

Table 4. ANOVA test results of participants' burnout levels according to their seniority

Dimensions		**N**	$\bar{X}$	**ss**	**t**	**p**
Personal	1-5 years	16	2,02	,80	1,581	,184
Failure	6-10 years	26	1,76	,60		
	11-15 years	28	1,49	,74		
	16-20 years	27	1,72	,86		
	20 + years	30	1,86	,68		
Emotional	1-5 years	16	1,36	,80	1,859	,122
Exhaustion	6-10 years	26	1,50	,59		
	11-15 years	28	1,92	,91		
	16-20 years	27	1,66	,83		
	20 + years	30	1,74	,58		
Depersonalization	1-5 years	16	1,13	,93	2,359	,057
	6-10 years	26	1,52	,88		
	11-15 years	28	1,97	1,03		
	16-20 years	27	1,55	,95		
	20 + years	30	1,72	,74		

Table 4 shows the scores obtained from the personal failure, emotional exhaustion and depersonalization dimensions of the Maslach Burnout Scale among teachers whose service period is one-five years, six-ten years, eleven-fifteen years, sixteen-twenty years and twenty-one years and above. There is no significant difference in terms of their averages (p>.05).

The findings of the one-way ANOVA test, which was conducted to determine the differentiation of special education teachers' burnout levels according to the length of time they worked in the institution, are included in Table 5.

Table 5. ANOVA test results of participants' burnout levels according to their seniority in school

Dimensions		**N**	$\overline{X}$	**ss**	**t**	**p**	
Personal Failure	1-5 years	44	1,65	,77	1,138	,342	-
	6-10 years	24	1,81	,59			
	11-15 years	22	1,58	,77			
	16-20 years	20	1,88	,82			
	20 + years	17	2,00	,68			
Emotional Exhaustion	1-5 years	44	1,30	,72	1,859	,001	A<C
	6-10 years	24	1,71	,47			A<E
	11-15 years	22	1,96	,87			
	16-20 years	20	1,83	,91			
	20 + years	17	1,96	,47			
Depersonalization	1-5 years	44	1,19	,91	6,961	,000	A<D
	6-10 years	24	1,48	,78			A<E
	11-15 years	22	1,73	,94			
	16-20 years	20	2,17	,98			
	20 + years	17	2,18	,39			

A: 1-5 years B: 6-10 years C: 11-15 years D: 16-20 years E: 20 + years

In Table 5, there is no significant difference in the mean scores obtained from the personal failure dimension of the Maslach Burnout Scale among teachers whose working period in the institution is 1-5 years, 6-10 years, 11-15 years, 16-20 years and 20 + years ($p > .05$).

There is a significant difference between the groups in terms of emotional exhaustion ($p<.05$). Bonferroni test was performed as a post-hoc test to determine the source of the difference. According to this test result, the emotional exhaustion levels of teachers who have been working at the institution for one to five years are significantly lower than those who have been working at the institution for eleven to fifteen years and those who have been twenty-one and over ($p<.05$). There is no significant difference between other study groups ($p>.05$)

There is also a significant difference between the groups in the depersonalization sub-dimension ($p<.05$). Bonferroni test was performed as a post-hoc test to determine the source of the difference. According to this test result, the depersonalization levels of teachers who have been working in the institution for one to five years are significantly lower than those who have been working at the institution for sixteen to twenty years and those who have been twenty-one and over ($p<.05$). There is no significant difference between other study groups ($p>.05$).

Conclusion and Discussion

In this section, the findings of the research conducted to determine whether the burnout levels of special education teachers differ according to their gender, education level, length of service and time spent in school will be discussed and some suggestions will be given.

Gender

As a result, the burnout levels of special education teachers were determined as personal failure ($t=-1.256$, $p>.05$), emotional exhaustion ($t=-1.773$, $p>.05$) and depersonalization ($t=-0.19$, $p>.$) according to gender. It was determined that it did not differ from the 05) sub-dimensions. Accordingly, gender is not a variable affecting the burnout level of special education teachers. The findings are incompatible with Ergin (1992) and Şanlı and Tan (2017), who reported that depersonalization scores differ significantly according to the gender variable. However, it is compatible with Özer (1998) study. This suggests that the gender variable may affect teachers' burnout levels in different ways under various conditions. The gender variable may affect the level of burnout through factors such as success or job satisfaction.

education level

As a result, it was determined that the burnout levels of special education teachers did not differ from the sub-dimensions of personal failure (t=-1.629, p>.05) and depersonalization (t=-1.170, p>.05) according to the variable of education period. However, there is a significant difference between undergraduate and graduate teachers in the emotional exhaustion sub-dimension (t= -2.036, p<.05). Emotional exhaustion levels of postgraduate graduates are higher than undergraduate graduates. Accordingly, it can be said that as the level of education increases, the emotional burnout levels of special education teachers increase.

Seniority

It was determined that the burnout levels of special education teachers did not differ from the sub-dimensions of personal failure (F=1.581, p>.05), emotional exhaustion (F=1.859, p>.05) and depersonalization (F= 2.359, p>.05) according to the length of service variable. . Accordingly, length of service is not a factor affecting the burnout level of special education teachers.

Sucuoğlu and Koluğlu-Aksaz (1996) in their study with special education teachers, according to teachers' burnout levels; There was no significant difference between the variables of length of service at school and type of school and the sub-dimensions. However, a significant relationship was found between gender, marital status and professional seniority variables and the depersonalization dimension (Sucuoğlu and Koluğlu-Aksaz, 1996; Girgin, 1995).

Working experince at special education school

There is no difference in the personal failure (F=1.138, p>.05) sub-dimension of special education teachers' burnout levels according to the variable of working time in the institution. However, statistically significant differences were determined in the emotional exhaustion (F=4.781, p<.05) and depersonalization (F= 6.961, p<.05) subscales. Accordingly, the emotional exhaustion levels of teachers who have been working at the institution for 1-5 years are significantly lower than those who have been working at the institution for eleven-fifteen years and those who have been twenty-one and over (p<.05). In addition, the depersonalization levels of teachers who have been working at the institution for one to five years are significantly lower than those who have been working at the institution for sixteen to twenty years and those who have been twenty-one and over (p<.05). While this result differs from the findings of the Şanlı and Tan (2017) study, it supports the findings of the Ensari and Tuzcuoğlu (1995) and Torun (1995) studies. According to these researchers' perceptions of teachers regarding burnout; determined a statistically significant difference between the length of time working at school and the type of school and the dimensions of the burnout scale.

Recommendations

- While receiving a master's degree is generally a positive and desirable feature, it should be investigated why emotional burnout increases as the level of education increases and the relevant factors should be eliminated. One reason for this situation may be that the expectations of teachers with increased education were not met.
- Special arrangements should be made for teachers with master's degrees and they should be made to feel that their efforts are valuable and that their expertise will be appropriately evaluated in various fields. Thus, emotional burnout levels can be reduced.
- It has been observed that teachers who have worked in the institution for eleven to fifteen years and twenty-one years and above have high perceptions of emotional exhaustion. According to this result; Studies and training can be conducted to increase the emotional exhaustion levels of teachers who have been working in the institution for eleven-fifteen years and twenty-one years and above.
- It has been observed that teachers who have worked in the institution for eleven to fifteen years and twenty-one years or more have high perceptions of depersonalization. According to this result; Studies and training can be carried out to increase the sensitivity levels of teachers who have been working in the institution for eleven to fifteen years and twenty-one years and above.

- Emotional burnout and depersonalization have a high impact on teachers' general burnout levels. Studies to improve teachers' emotional burnout and depersonalization levels will also positively affect teachers' general burnout levels.

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Research Article

Mathematics teachers' perspectives on the use of math teaching materials

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Abstract

The aim of this study is to reveal the perspectives of secondary school mathematics teachers about the use of materials in mathematics teaching. For this purpose, the teachers' use of materials, the materials they have used, and their views on the role of using materials were analysed. In this context, the research was conducted with case study, one of the qualitative research designs. In accordance with the purpose of the research, easily accessible case sampling method was used to form the study group. The data of the study were collected from eight secondary school mathematics teachers working in different schools on a voluntary basis with a semi-structured interview form consisting of three open-ended questions about the use of materials in mathematics teaching. The interviews were audio recorded and the dialogues were transcribed. The data obtained were analysed by content analysis method. As a result of the study, it was determined that teachers' perspectives on the use of materials were built on four themes: the role of purpose of use, the role of effect on teaching, the role of effect on students and the materials used. Regarding the purpose of using the material, it was determined that most of the teachers emphasised the role of attracting attention to the lesson, the role of concretisation as the effect on teaching, and the role of facilitating understanding and remembering as the effect on students. Although the teachers stated that the use of materials had a positive effect, it was concluded that their use in the application dimension was at a low level. Another striking result of the study was that the concrete materials that some teachers stated that they used were actually course materials. When the focus was on what they used as materials, it was determined that all of the examples given were concrete materials actively used in the geometry learning domain. In addition, only one of the eight teachers participating in the study mentioned virtual learning objects (manipulatives) other than concrete materials as materials.

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Introduction

As in every branch, there are updates in mathematics and mathematics teaching. One of the current updates is the teaching of the abstract structure of mathematics by concretising and visualising teaching (Öksüz & Uça, 2011; Baki, 2002). While explaining the approaches of mathematics teaching programmes, it is stated that they are based on the active participation of students in the process of doing mathematics and that students in this age group will form their own ideas from their interactions with their environment, concrete objects and peers (Kutluca & Akın, 2013). As Ergin (1995) stated, when it is considered that appealing to more senses results in more permanent learning, the use of materials in teaching has positive effects and provides permanent learning (Çelik, 2007). In this framework, the use of materials

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has become an important tool especially in primary and secondary school mathematics teaching (Bozkurt & Polat, 2011; Bozkurt & Akalın, 2010). The role of material use in mathematics lessons has made it inevitable to carry out many concrete material-oriented studies. For example, in a study on the use of concrete materials, Kelly (2006) concluded that the use of concrete materials in mathematics teaching contributed positively to students' learning and problem solving skills at primary school level. In a study (Kıyıcı, Erdoğmuş, & Sevinç, 2007), which examined the opinions of pre-service teachers about the contribution of using concrete materials in the classroom environment to teaching, it was concluded that the use of materials facilitates learning and improves psychomotor skills.

In the study conducted by Domino in 2010 with meta-analysis method, it was compared whether teaching with concrete materials and teaching with traditional method made a difference in terms of students' mathematics achievement. As a result of the research, it was concluded that the use of concrete materials in students from kindergarten to 6th grade level increased student achievement.

Dokur (2013) examined the effect of using concrete materials and Geometer's Sketchpad supported applications on the achievement and mathematical explanations of prospective mathematics teachers. In this quasi-experimental study, he concluded that the students who were taught with technology-supported applications made more convincing explanations for mathematical problems. Kadagöl (2018) examined the effect of using materials in mathematics lesson on the mathematical skills of 8th grade students. As a result, it was concluded that the use of materials in mathematics lessons contributed positively to students' mathematical skills.

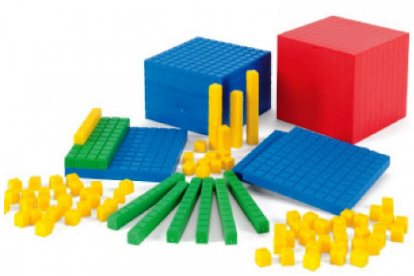
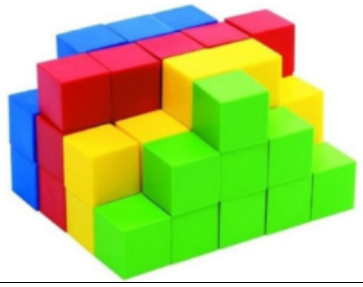
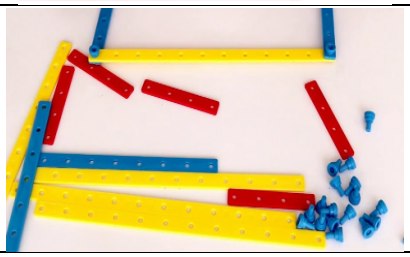
When the studies given above are examined, many studies have been conducted on the effect of material use on student achievement, its effect on teaching, and its effect on student beliefs and attitudes. In addition, it is seen that there are also studies on the attitudes of pre-service teachers and teachers towards the use of materials. Although the use of materials contributes so much to the effectiveness of teaching, there are some problems regarding the use of materials in mathematics teaching. Although researchers state that this situation is caused by many reasons, teachers' knowledge, attitudes and beliefs on this issue are important factors (Stein & Bovalino, 2001). Therefore, the views of teachers, who are responsible for the design and structuring of instruction, on the use of materials are a matter of curiosity. The problem statement of the research is "What are the perspectives of secondary school mathematics teachers on the use of materials in classroom teaching practices?".

Materials used in mathematics teaching

Materials designed to represent abstract mathematical concepts and used in classroom mathematics teaching lessons are fixed or movable objects that activate more than one sense organ of students (Bozkurt & Akalın, 2010). The materials can be base ten blocks, fraction cards, counting stamps, geometry boards or computer software (virtual manipulatives).

Tangible materials provide students with a practical learning opportunity during teaching based on the feature of appealing to multiple senses of students (Moyer, 2001). With this definition of tangible materials, the necessity of using tangible materials in teaching is understood, especially when the characteristics of students at primary and secondary school level are examined. As a matter of fact, Clements and McMillen (1996) emphasised that elementary school students learn mathematical abstract concepts and information more meaningfully in a learning environment represented by concrete models. Examples of concrete materials whose effectiveness in terms of teacher and student in mathematics teaching has been demonstrated by various studies are shown in Table 1.

Table 1. Some examples of concrete materials used in mathematics teaching and their usage areas

Examples of concrete materials	Area of use	Visual	
Base blocks of tens	It is used to model comparing, ordering, adding, subtracting, multiplying and dividing decimal fractions. This material is used to present the hierarchy of numbers (one, ten, hundred, thousand) in geometric form.		Web 1
Unit cubes	Used in area and volume calculations and to express spatial relationships		Web 2
Geometry board	Geometric shapes such as triangles, squares and circles can be made with tyres on the geometry board. It is used to find a closed area formed on the geometry board by dividing it into shapes whose areas we can simply calculate.		Web 3
Pattern blocks	Pattern blocks are used for creating patterns, establishing perimeter and area relationships and symmetry.		Web 4
Fraction bars	Fraction bars are used for teaching, comparing and ordering fractions.		Web 5
Geometry strips	It is used to construct different geometric shapes. It helps to see the properties of the shapes created with strips of different lengths and the relationships between them.		Web 6

In addition to the use of concrete materials in mathematics teaching, there are also studies on the use and effect of virtual manipulatives as materials. When Moyer, Bolyard, and Spikell (2002) first defined virtual manipulatives, they referred to them as web-based interactive learning tools that can be moved with a computer mouse. With the advances in technology, virtual manipulatives are operated with devices such as tablet computers and smartphones in addition to computers (Moyer-Packenham & Bolyard, 2016). Virtual manipulatives, which are 2D or 3D digital versions of concrete materials, are developed as web-based or application (Bouck & Flanagan, 2010). Some virtual manipulatives used in mathematics teaching are shown in Table 2.

Table 2. Examples of virtual manipulatives and their websites

Virtual manipulatives	**Web sites**
National Library of Virtual Manipulatives	Web 7
Illuminations from the National Council of Teachers of Mathematics	Web 8
MathTools	Web 9
The Math Learning Center	Web 10

Importance of research

All activities that can be done to teach the content of a teaching are carried out in the learning-teaching process dimension of the education programme (Demirel, 2007, 44). Questions such as what kind of learning activities will be done, when, where, how, how long and by whom they will be taught and learnt are within the scope of this dimension (Özbek, 2007, 138). One of the elements included in the learning-teaching process, which has a dynamic structure, is the materials used during teaching. Karakırık and Aydın (2011) put forward the idea that the ideas about the use of materials in the learning-teaching process have an effect on the quality of the process with the statement "The use of an educational tool without determining its place in the learning-teaching process is not sufficient to increase the quality of the learning process (page 20)."

It is thought that determining what kind of materials teachers prefer for what purposes and their perspectives on materials will gain importance in terms of the design of learning environments to be formed during classroom teaching practices. For this reason, it is important to determine teachers' perspectives on the use of materials in teaching. It is thought that the results obtained at the end of the research will contribute to the literature to know what the ideas brought to the forefront in the teachers' perspectives on the use of materials, what their perceptions of the concept of materials are, and which materials are primarily evoked in their minds when it comes to the use of materials.

Research Problem

The aim of this study is to determine the perspectives of secondary school mathematics teachers towards the use of materials in mathematics lessons. In line with this purpose, answers to the following questions will be searched.

- Which materials do secondary school mathematics teachers use in their mathematics lessons?
- What are the views of secondary school mathematics teachers on the role of using materials in mathematics lessons?

Method

Research Model

In this study, which was conducted to reveal the perspectives of secondary school mathematics teachers on the use of materials in mathematics lessons, a case study from qualitative research methods was adopted. Qualitative research method is a research method carried out with the participation of a limited number of people to understand the reasons for human behaviours and thoughts on any subject (Patton, 2014; Yıldırım & Şimşek, 2011). Bernat and Gvozdenko (2005) emphasise that the case study is qualitative in nature and contributes to an interpretive paradigm and states that it is a research approach that facilitates the exploration of a phenomenon in its own context by using various data sources (Baxter & Jack, 2008). Therefore, case study is considered to be an appropriate approach for the purpose of the research.

Study Group

The study group consisted of eight mathematics teachers working in public secondary schools affiliated to the Ministry of National Education (MoNE) in a city in the Southeastern Anatolia region. Each teacher was given a code and they were represented with these codes in the presentation of the findings. Information about the participants and their codes are presented in Table 3.

Table 3. Structures and coding of the mathematics teachers participating in the study

Participant No	Gender	Seniority	Teaching class	Codes
P1	F	1-5 years	5th grade	P1-F
P2	M	16 years +	7th grade	P2-M
P3	M	16 years +	8th grade	P3-M
P4	F	1-5 years	6th grade	P4-F
P5	M	6-15 years	7th grade	P5-M
P6	M	1-5 years	7th grade	P6-M
P7	F	6-15 years	5th grade	P7-F
P8	M	16 years +	8th grade	P8-M

When Table 3 is analysed, it is seen that the participant group provided diversity in terms of the grade level, professional experience and gender.

Data collection process and analysis

Semi-structured interviews were conducted with a total of eight teachers. In the interview form, questions about the participants' use of materials in mathematics teaching, the materials they used, and the purpose of using materials were included. These questions were as follows;

- Do you use materials in your lessons? Explain.
- What are the materials you use? Explain.
- For what purpose and how do you use these materials? Explain.

It was paid attention that the questions in the interview form were understandable, open-ended and flexible. After the interview form was prepared, the opinions of two field experts were consulted and necessary arrangements were made. The interviews were conducted face-to-face according to the available time of the teachers. The interviews with the participants were recorded with permission. Content analysis was used to analyse the data obtained from the interviews.

Firstly, the participant responses were converted into a text file in computer environment without any changes by the researcher. In the file created, the answers given for each open-ended question in the interview form were listed and created descriptively. As a result of the creation of the whole file, the texts were read independently by both the researcher and the mathematics education specialist, and possible themes and codes were created. The independently created themes and codes were compared and finalised. The data obtained were categorised under four themes in total. In order to ensure the reliability of the research, the field expert was asked to match the codes with the themes. The matching made by the researcher was compared with the matching made by the field expert. Miles and Huberman's (1994) formula was used to calculate the percentage of agreement. Accordingly, the agreement was calculated as 92%. In addition, while interpreting the themes obtained from the data, direct quotations were included to ensure reliability and validity. Then, the codes belonging to the determined themes were presented in tables as frequency values and sample quotations.

Ethics

A wet signed form was obtained from the teachers in the study group indicating that they participated voluntarily.

Results

It was determined that secondary school mathematics teachers' perspectives on the use of materials were built on four themes: materials used , purpose of use, effect on teaching, effect on students. The results of each theme will be presented separately.

Materials used

The findings of the answers given by the teachers about the materials they used in their mathematics lessons are shown in Table 7.

Table 7. Content analysis of mathematics teachers' views on the materials they use in mathematics lessons

Materials used	**f**
Concrete materials: tangram, unit cubes and geometry board	2
Technological: Virtual manipulatives,	1
Other: Pencil, paper, board, compass, ruler, square, slide, projector	8

When Table 7 is analysed, all of the teachers stated that they used compass, ruler and square as materials. It is a remarkable finding that teachers defined course materials as materials. In addition, it is another remarkable finding that only one teacher from the participant group mentioned virtual learning objects (virtual manipulatives) other than concrete materials. When we look at the concrete material examples, it is seen that all of the examples given are related to geometry learning domain.

Purpose of use

The findings regarding the role of teachers' purpose of using materials in mathematics teaching are given in Table 4.

Table 4. Content analysis of teachers' views on the purpose of using materials in mathematics teaching

Purpose of Use	**Description**	**f**	**Quote**
Retention in learning	When learnt, they are expressions in the form of keeping and remembering in their long-term memory.	2	"I use it so that the lesson will be permanent and the student will keep it in his/her long-term memory when he/she learns it." (P3-M)
Developing the ability to use	Showing how to use, teaching, showing how to create.	2	"For example, think of a protractor, I show the children how to use it, how to measure it." (P1-F) "For example, since the children have never seen a tangram, I show them how to create a shape in geometry on the geometry board to show how to use it." (P5-M)
Ease of learning	Showing the shapes more clearly, using them while solving sample problems.	1	"I use materials such as computer and projection mostly while solving examples." (P6-M)
Drawing attention to the lesson	While telling what the subject is in the introduction of the lesson, it is the expressions that it appeals to different sensory organs.	3	"I usually use that material at the beginning of the lesson to attract attention." (P8-M)
Making the subject understandable	The expressions of understanding the subject more clearly and being descriptive.	2	"I use it in the lesson to show the shapes more clearly, to make them clearer." (P4-F)

When Table 4 is analysed, it is seen that there are different roles that teachers attribute to the material in the background of using materials in their lessons. As a matter of fact, when these roles are focused on, it is seen that there are teachers who use the material in order to provide retention in learning as well as teachers who use the material only to attract students' attention to the lesson. While it can be said that the purpose of using the material of the teachers who mentioned the roles of permanence in learning and making the subject comprehensible is related to the goal of realising a meaningful learning in the presentation of the course content, it can be said that the purpose of using the material of

the teachers who mentioned the roles of developing the ability to use, ease in learning and attracting attention to the lesson is related to the goal of using it as a tool in the presentation of the course content.

Impact on teaching

The findings regarding the role of teachers' views on the effect of using materials in mathematics teaching on teaching are given in Table 5.

Table 5. Content analysis of teachers' views on the effect of using materials in mathematics teaching on teaching

Impact on Teaching	Description	f	Quatos
Explanatory role	Statements indicating that it is easier to explain to students and helps to prevent misconceptions	2	*''It is easier to explain the subject to children. There is a more detailed explanation.''(P1-F)* *“Students understand better because it is visual and there are no misconceptions.''* *(P6-M)*
Challenging role	Statements that are difficult to explain the material to the students and then to establish its relationship with the lesson.	2	*"Actually, it seems to be good, but it is a bit difficult, even the boards slip, I can't use it very well, to be honest.* *(P8-M)*
Embodiment role	Statements that are thought to be useful for explaining abstract concepts and concretising the lesson.	3	*''It makes it concrete, mathematics is already an abstract subject, but since it makes it concrete for children to understand, it is useful for teaching the subject.''* *(P3-M)* *"Some things you cannot explain verbally, but they are more easily understood and concretised visually."* *(P4-F)*
Time saving	Statements that explain more things in a shorter time.	2	*"It is useful to give more in a shorter time.* *(P6-M)* *"Since the students immediately see it themselves, it is processed more quickly, you can explain what you are going to explain in a shorter time.* *(P7-F)*

When Table 5 is examined, it is seen that the teachers mostly mentioned the role of concretisation as the effect of material use on their teaching. In addition to this, it is seen that there are those who say that it saves time in teaching, as well as those who mention the role of making it difficult because they have difficulty in using it.

Impact on the student

The findings regarding the role of teachers' views on the effect of using materials in mathematics teaching on students are given in Table 6.

Table 6. Content analysis of teachers' views on the effect of using materials in mathematics teaching on students

Impact on Students	Description	f	Alıntı
Facilitating understanding	These are the statements indicating that the students understand better and create an infrastructure in comprehending the subject.	3	*"When the child starts life, he/she will create an infrastructure, it provides permanence.(P1-F)* *"It enriches their understanding, students understand more easily. (P4-F)* *"Students learn more easily because they see it." (P7-F)*
Being interesting	These are the statements that students are more interested and enthusiastic about the lesson.	2	"Students have fun above all." (P8-M)
Enabling recall	These are the statements that it helps to make connections and mediates in making recall.	3	*""They remember more easily when they make recollections, when I ask them if they remember, they say yes, we did it in the activity and it is related to this subject".* (P5-M)

When Table 6 is analysed, when the teachers evaluated the effect of material use on students, they mostly mentioned the roles of facilitating comprehension and ensuring recall.

They also stated that it was interesting for the students and accordingly, they seemed more willing in the lesson. Apart from the above-mentioned roles regarding the effect of material use on students, there are also teachers who think that material use is not considered important for students and has no effect on students. They express that this situation is not taken into consideration by the students because it is not included in the exam system (''students do not care too much, they are not inclined, they do not dwell on it because there are no questions."P2-M)

Conclusion and Discussion

In this study, the perspectives of secondary school mathematics teachers on the use of materials in their lessons were tried to be revealed. In line with the findings, it was concluded that teachers have roles that serve different purposes in the background of using materials in mathematics teaching. Although teachers attributed different meanings to the use of materials in teaching, it was observed that they remained at a very weak level in using them in practice. It is a striking result that although teachers know that the use of materials in their lessons is theoretically important, they do not reflect it in practice. This leads to the idea that although teachers know the importance of using materials, they lack knowledge and skills in the use of materials. The use of materials in classroom teaching practices makes students active, provides richer learning opportunities, makes mathematics teaching fun and increases students' interest in the lesson. Although it is predicted that the use of materials supports teacher-student and teaching in theory, studies have shown that it does not give consistent results in practice (Özdemir, 2008). Researchers state that the knowledge, beliefs and attitudes of teachers on this subject are an important factor as one of the reasons for this result (Özdemir, 2008). As a matter of fact, when we look at the literature, there are studies on teachers' not knowing how to use the materials (Bozkurt & Şahin, 2013).

It was seen that teachers prioritised the roles of attracting attention as the purpose of using materials in mathematics lessons, providing concretisation as the effect on teaching, facilitating understanding and ensuring recall as the effect on students. When we look at the literature, it is seen that there are studies that support the research result. Tunç et al. (2011) stated that materials designed to present abstract mathematical concepts in a concrete and clear way by visualising them help students to think creatively and learn meaningfully. According to the study conducted by Gökmen, Budak, and Ertekin (2016), it is possible to say that there are similar results. As a result of the study, it was revealed that the biggest advantage of using concrete materials according to mathematics teachers is that it facilitates learning. In the same study, according to classroom teachers, the advantage of using concrete materials is that it enables learning by doing and experiencing. This is in parallel with the results of our research. When the studies in the literature are examined, it is

stated that the use of materials visualises and concretises the subject to be learnt and this makes what is learnt permanent (Clements, 2000; Thompson, Lambdin, 1994).

A striking result of the study was that although the teachers mentioned the positive role of the use of materials in mathematics lessons, there were teachers who thought that the use of materials was not considered important for students and had no effect on students. When we look at the literature, in the studies examining teachers' views on the use of materials, there are studies indicating the negative aspects of the use of materials such as taking too much time, not being able to understand mathematical concepts by students due to the difficulty of classroom control, and not having enough materials to be used (Uzundağ & Yazıcı, 2019; Yazlık, 2018; Gökmen, Budak, & Ertekin, 2016). However, here, it is considered as a finding that needs to be elaborated that the teacher's negative aspect of the use of materials is that they are not taken into consideration by the students because they are not included in the exam system.

When we look at the literature, there are studies in which no significant relationship was found between teachers' theoretical beliefs about the use of materials and their theoretical beliefs, although their theoretical beliefs and outcome expectations were high (Gökmen, Budak, & Ertekin, 2016). Since materials (concrete and/or virtual manipulatives) and lessons designed through these materials are fun and different for students, teachers believe in the necessity of using materials, but they do not use them actively due to time limitations and lack of materials.

Another striking result of this study was that what most of the teachers stated as materials were actually course materials. What they perceive and use with the concept of material are the basic tools and materials used in many subjects of mathematics course. Most of the teachers did not know the subject-specific materials and it was seen that all of the materials they mentioned as concrete materials were materials related to the field of geometry. It is thought that this situation gives a clue that teachers have the perception of matching the use of materials only with the geometry domain.

Recommendations

Recommendations for practitioners

In line with the findings obtained, it was seen that although the teachers were of the opinion that the use of materials had a positive effect on learning, they used the materials very little. For this reason, teachers can participate in in-service training seminars on the introduction and use of materials, and social networks can be provided where they can provide professional development. In addition, in order to increase the use of materials by teachers in their lessons, it can be suggested to meet the material needs of schools and to provide mathematics laboratories where they can access both concrete materials and virtual manipulatives. In addition, it is thought that teachers should make a good planning for the purpose of using the material before the lesson for the lessons in which they will use the material.

Recommendations for researchers

This study was limited to eight secondary school mathematics teachers. In future studies, the study can be quantified by applying to teachers' opinions in different regions and general results can be revealed. In addition, a scale development study can be conducted to determine teachers' competences in using materials.

A similar study can be conducted with pre-service teachers. By revealing the data about pre-service teachers' recognition and use of materials, it can be explained how they recognise the materials or where and how they use them. Thus, the perspectives of different participant groups on the use of materials can be compared and their reasons can be investigated. In addition, the knowledge and self-efficacy of teachers who know and use some materials very little can be revealed through qualitative studies.

Limitations

The research is limited to eight secondary school mathematics teachers in a province in southeastern Anatolia. In addition, the data obtained in the research are limited to the open-ended questions in the interview form.

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Web 6. https://www.youtube.com/watch?v=8kIPNZqJBIs

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Web 8. https://illuminations.nctm.org/content.aspx?id=3855

Web 9. http://www.mathforum.org/mathtools/

Web 10. https://www.mathlearningcenter.org/resources/apps

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Research Article

Subject, functionality and level of proofs preferred by pre-service elementary mathematics teachers

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Abstract

This study examined the subject(s) that elementary mathematics teacher candidates find most suitable for proving in analysis courses, the functional structure of proof they remember most, the level of proof, and the reasons for preferring this proof. In this study, which was conducted with a qualitative research approach, a form consisting of open-ended questions was applied to teacher candidates. In this form, teacher candidates were asked questions about the mathematical proofs they made. With descriptive analysis, the answers of the pre-service teachers who participated in the research were systematically defined, and data were tried to be determined through content analysis. Accordingly, while the pre-service teachers found the most appropriate application of the proof approach to be the subject of trigonometry, it was determined that the proof that remained in their minds the most was also related to the topic of trigonometry. By examining the functional structure of these proofs written by pre-service teachers, it has been seen that they have the function of explanation and systematization. In addition, the reasons for preferring the proof they made were asked of the pre-service teachers, and the answers were gathered on the fact that proof provides the most permanence and causal learning. It was emphasized that theorems that require formula memorization generally become more understandable with the proof method. According to the results of the research, the common opinion of the pre-service teachers is that teaching how to obtain the proof method of formulas in trigonometry instead of memorizing them is beneficial in ensuring both meaningful and permanent learning. In light of the findings of these studies, more sensible suggestions can be made to improve pre-service teachers' knowledge systems and classroom teaching on proof. By determining which topics and theorems pre-service teachers have difficulty in proving in addition to trigonometry, additional learning on these subjects can be recommended.

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Introduction

There are many theorems in the light of operational and conceptual knowledge in mathematics education. These theorems are not just a formula but represent a semantic whole based on different mathematical ideas and propositions. A mathematician uses valid logical inferences rather than empirical and observational results to demonstrate the truth of a mathematical statement and proposition (Hanna & Barbeau, 2002). All of these logical inferences lead us to the

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concept of mathematical proof. Mathematical proof includes revealing relationships, making predictions, relating concepts, verifying statements, and generalizing new information (Schabel, 2005). Proving has an important place in mathematics education. The primary purpose of advanced mathematics courses is to provide students with the ability to prove theirs. Students' proficiency in proving is seen as an assessment of their performance (Weber, 2001). Proof has different educational functions. Mathematical proof helps to understand the meaning of the given theorem and shows both the correctness of the theorem and why it is true (Hanna, 2000). Also, proofs have different benefits and functions. Some of these benefits are helping to create good definitions and practical algorithms contributing to systematizing results and formalizing mathematical knowledge. There is a systematic classification in the literature for the different proof functions. The following is a valuable list of the functions of proof and proving (de Villiers, 1990, p.5):

Verification (concerned with the truth of a statement): One of the proof functions that mathematicians are most familiar with is verification. Accordingly, a statement or proposition is only considered a theorem if its correctness has been demonstrated. Verification is understood as demonstrating the truth of a mathematical proposition. Many mathematicians believe that the proof provides absolute certainty and is the absolute authority in ensuring the claim's validity. The experiment has an important place in ensuring the accuracy of scientific facts, and the proof has an important place in ensuring the accuracy of mathematical facts. However, while proof is not a necessary prerequisite for verification, verification is a prerequisite for proof.

Explanation (providing insight into why it is true): The role of proof and explanation is generally emphasized in the lessons. In most mathematical content, proof should explain why a proposition is true rather than show that it is true. On the other hand, although a claim's validity can be mainly ensured by verification, more is needed as to why the claim is valid. In this context, the explanatory function of the proof provides sufficient confidence about why the claim is valid. However, limiting this role of proof only to course content is incorrect.

Systematization (organizing various results into a deductive system of axioms, significant concepts and theorems): This proof function is mainly encountered in Euclid's book Elements. In this book, many theorems that Greek mathematicians proved are collected and arranged as theorems, definitions, axioms and postulates. There are also enough definitions, axioms, and postulates to develop Euclidean geometry. In addition, the first essential results of number theory, such as divisibility rules, prime numbers and factorization, are also included. By systematizing mathematics, mathematicians can eliminate the unnecessary redundancy of definitions and axioms and have the opportunity to capture all the necessary concepts and ideas with a small set of them.

Discovery (the discovery or invention of new results): This function of proof is rare. Historically, theorems of some areas of mathematics, such as non-Euclidean geometries, have been arrived at through abstract deductive reasoning. For example, in Euclid's fifth postulate of parallelism, non-Euclidean geometries emerged through theorems describing the geometry of shapes in curved surfaces rather than planes.

Communication (the transmission of mathematical knowledge): The communication function of proof refers to the reading and writing of proofs by people. According to this function, proofs are seen as a means of communicating mathematical results among people. Moreover, proofs can offer a new approach or technique, providing opportunities for other mathematicians to complete and develop a different theorem(s) of their own.

Intellectual challenge (self-realization derived from constructing proof): For mathematicians, proof is an intellectual challenge. In this sense, proof serves the function of self-actualization and realization.

The functions mentioned above of mathematical proofs may differ depending on the person who makes and reads the proof. In this context, the purpose and proficiency of a mathematical proof differ. Although mathematical proof is one of the essential concepts in mathematics that distinguishes mathematics from other sciences, it is one of the concepts that students have difficulty understanding (Arsac, 2007). Proving is at every level of education. Although the concept of mathematical proof is central in university-level mathematics courses, research indicates that some students at this level need help to understand what proof includes and how it is developed (Jones, 2000).

Literature Review Related to the Research Topic

When the literature is examined, many studies are on levelling the arguments created by students (Balacheff, 1998; Knuth et al., 2009; Miyazaki, 2000). Researchers defined different levels for the proofs made by individuals and classified the proofs made according to these levels. For example, Balacheff (1998) introduced three levels of proof; pragmatic proofs, intellectual proofs and demonstrations. In pragmatic proof, which is the lowest level of proof, representations are made with representations of mathematical objects. In intellectual proof, the statements in the question and the relationships between these statements are formulated. At the demonstration level, information explained by a theory or accepted by a community is used. Miyazaki (2000) divides proof into four groups proof A, proof B, proof C, and proof D. Proof A represents the most advanced proofing skill. Proof C represents the lowest category in the proof-making process. Proof B and Proof D are intermediate between Proof A and Proof C. The use of language, inductive reasoning and method preferences effectively made this classification. Knuth et al. (2009) divided individuals' proofs into four levels. Level 0 individuals need to be made aware of using mathematical proofs to demonstrate the correctness of the situation. For example, a student accepts that situation because his teacher says it is true. The level 1 individual is aware of the need for proof, but in this process, they only verify the situation by using special situations. Level 2 individuals, on the other hand, either need to be able to reach the generalization by using a wrong method in the generalization process or completing the proof correctly. Individuals at the highest level, level 3, generalize and reveal the truth of a statement with appropriate methods and arguments. Along with all these studies, when studies examining pre-service teachers' proving levels are examined, it is stated that pre-service teachers' level of proving is low (Jones, 2000; Weber, 2005). In the literature, it is possible to find studies not only about the level of proof but also about all proof processes in general. Proving has been seen as a process in which students cannot be successful or a process in which they believe they will not succeed at every stage of education (Morris, 2002; Raman, 2003). Recent studies documenting teachers' fragile understanding of proof and how it progresses show that improving the role of proof in school mathematics should significantly support teacher learning (Lesseig, 2016). In addition, researchers state that one of the ways to reach classroom practices and student learning underlined by educational reforms is to change the course materials used during the course (Cai & Howson, 2012). According to this result, we again come across teacher competencies. In that case, the emergence and development of the ability to prove to lie in that teachers create opportunities for students to improve these skills (Bieda et al., 2014). Along with this requirement, it is seen that proof studies reveal that students have difficulties in proving (Stylianides & Stylianides, 2023; Urhan & Bülbül, 2016; Weber, 2001). In one of these studies, the current difficulties were explained in detail. It was revealed that when the pre-service teachers were asked to "prove or show that it is true", they did not question, did not have knowledge about alternative proof methods, and insisted on using the proof methods they were familiar with (Demircioğlu, 2023, p. 331). In a different study conducted with teachers and students on eliminating these difficulties, it was stated that visual proof provides a better learning experience (Polat & Akgün, 2023). However, to date, little research details what mathematical knowledge can support teaching proof or how professional development can accommodate such learning. This article examines the different aspects of proof making and wishes to present a holistic result that combines these details.

Purpose and Importance of the Research

In the last part of this study, it was mentioned that proof has an important place in mathematics, together with the studies on the purpose of proof, levels of proof and inadequacies. Since proof is a multidimensional process, studies investigate different parameters related to proof. Along with this high degree of importance of proof, different studies examine the functionality of proof and skills of proving. A literature review conducted for the analysis course examined the characteristics of proofs and correct proof ratings (Doruk & Kaplan, 2017; Kotelawala, 2007; Saeed, 1996). Differently from the literature, in this study, the subject that the students found the proof to be most appropriate, their level of proof, the functionality of the proof that remained in their minds the most, and the reason for choosing this proof were examined. Because one of the purposes of proof is to provide meaningful and permanent learning, for this reason, the students were asked only the proof that remained in their minds without any guidance or proof of a theorem. Thus, the functional structure of the proof that has the most permanence effect was sought to be examined. Although

there are different mathematics courses at the university level, one of the most important courses in the curriculum is analysis (Hartter, 1995). Therefore, the research is designed for the proofs in the analysis course because there are many mathematical proofs and fundamental theorems in the analysis course. In connection with this, it was observed by the researchers that the students in the analysis courses at the university needed help in the process of proving.

For this reason, researchers left the choice of subject or theorem to students to prove. Thus, they wanted to examine the proof preferences of the students without any guidance. In particular, they wanted to observe whether their students needed help proving the subject/theorems they chose according to their preferences. Moreover, the students were asked why they preferred the proof they chose. Thus, it is aimed to establish a connection between the most memorable proof, its functionality, its subject and the reason for preference. The difference between this study from other studies in the literature is that there is no question or theorem orientation in the proof processes for students. In addition, when the literature is examined, it is possible to find many studies on levelling the arguments created by students (Balacheff, 1998; Bell, 1976; Harel & Sowder, 1998; Healy & Hoyles, 2000; Quinn, 2009). However, in this study, along with the levelling of proof, the purpose of proof has also been examined in integrity. In this context, it will bring a different perspective to the literature.

In this study, which was carried out in light of all this information, the subject that the pre-service teachers found most suitable for proof in analysis courses, the functional structure of the proof that remained in their minds the most, and the reasons for preferring this proof and the level of proof were examined. In addition, whether there is a relationship between the subject that pre-service teachers prefer to prove the most, the proof that remains in their minds the most, and the reasons for choosing proof has been investigated. Regarding the analysis course, the tendency of the pre-service teachers to prove, the subject they prefer to prove, and the choice of proofs with the highest permanence level. It is thought that related studies will contribute to field educators and literature on meaningful and permanent learning, which is the primary purpose of proof. The teaching to be done by considering the pre-service teachers' preferences and thoughts on the proof will be more beneficial than the current teaching.

Method

Research Model

Within the scope of this research, while examining the opinions of the pre-service teachers about the subject they prefer to prove, the functionality of the proof they remember the most, and the reasons for preferring proof, case study, one of the qualitative research approaches, was used. The essential feature of the case study is the in-depth investigation of one or more cases. In other words, the factors related to a situation (environment, individuals, events, processes, *etc.*) are investigated with a holistic approach and focused on how they affect the relevant situation and how they are affected by the relevant situation (Yıldırım & Şimşek, 2008). This study aims to reveal the pre-service teachers' preferences for proof in analysis courses, the proof they keep in mind the most and its functional structure, their level of proof, and their views on proof relationally and holistically. In this case, this study focused on more than one situation. According to Yin (2003), when the case study includes more than one analysis unit, it focuses on the sub-unit or sub-units within a situation. This situation emerges in nested case studies. Yin (2003) defines a case study as a research method that is used when i) the research focuses on "how" and "why" questions, ii) the researcher has little or no control over events, and iii) the event or phenomenon is studied within the framework of its natural life. In this study, the participant's level of proving, the function of their proofs, their subject preferences in the proof and the reasons for these preferences were examined holistically without giving any direction to the participants. Therefore, this study is defined as a nested case study. The situations in this study are the pre-service teachers' preferences for proof in analysis courses, the most memorable proof, its functional structure, the level of proof and their views on proof and the relationship between them.

In this study, all rules stated to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions stated under the title "Actions Against Scientific

Research and Publication Ethics", which is the second part of the directive, were not taken. The study was approved by the Izmir Demokrasi University Human Subjects Research Ethics Committee (Date: 8 April 2022, Number: 22/04-03).

Participants

The study group of the research consisted of four pre-service teachers studying in the department of elementary mathematics education in the 2021-2022 academic year. A purposeful sampling method was followed to conduct interviews. Purposeful sampling methods emerged within the qualitative research process. Purposeful sampling allows for an in-depth study of situations that are thought to have rich information (Yıldırım & Şimşek, 2008). In this sampling, criteria that are considered essential for selection are determined. It is thought that the sample selected according to these criteria can represent the research population with all its qualities (Tavşancıl & Aslan, 2001). It was thought that interviewing teacher candidates whose letter grades in Analysis 1-2 courses were AA-BA was important in reflecting their views on proof. Because the studies in the literature stated that proving is a complex process and is closely related to the academic success of the students (Arslan, 2007; Çalışkan, 2012), therefore, it was thought that it would be more accurate to select students with high academic achievement as the study group. Students with high academic success in the analysis course were selected by examining the grade list of the previous semesters. As a result, it was thought that interviewing the pre-service teachers whose letter grades in Analysis 1-2 were AA-BA was important in reflecting their views on proof. These elections were made voluntarily.

Data Collection and Analysis

In the study, in terms of holistic analysis, the subject that the pre-service teachers found appropriate to be explained with proof within the scope of analysis 1-2 course and the reason for their choice of proof and preference were asked with the help of a form consisting of open-ended questions. It is foreseen that this form will be completed in approximately 30 minutes, and therefore it was decided to give this time to the participants in this study. In this form, three questions were asked of the pre-service teachers.

- Which subject is most suitable for proof within the scope of analysis courses?
- Which proof remains in your mind the most within the scope of analysis courses?
- Complete the sentence "I chose this proof because...". What is your reason for choosing proof within the scope of analysis courses?

These statements were determined by the researcher and a mathematics education expert, and it was agreed that the questions were suitable for the content and purpose of the research, and content validity was ensured. The mathematics education expert was an educator with a master's degree in mathematics education. Coding reliability was calculated using the percent of agreement index. Percent of agreement is an index found by calculating the ratio of the cases in which the same coding is made to all existing cases. In this way, the coding reliability was found to be 0.91 using the percentage of agreement. The percentage of agreement is expected to be higher than 70% (Tavşancıl & Aslan, 2001). The result obtained is an appropriate percentage for this study. The data obtained at the end of the research process were subjected to descriptive and content analysis. With descriptive analysis, the answers of the pre-service teachers who participated in the research were systematically defined, and data were tried to be defined through content analysis; The data, which were found to be similar and related to each other, were brought together and interpreted within the framework of specific concepts and themes. The functional structure of the proof, which the pre-service teachers most remember, was examined categorically according to the purposes of the proof stated in Hanna's (2000) study. Because it is essential for the result of the research to determine for what purpose the pre-service teachers did the proof. Thus, it is planned to establish a holistic relationship between the subject of the proof and the purpose of the proof. The data on the functional structure of the proof are given in Table 1.

Table 1. Functions of proof

Function Themes
Verification (concerned with the truth of a statement)
Explanation (providing insight into why it is true)
Systematisation (the organization of various results into a deductive system of axioms, major concepts and theorems)
Discovery (the discovery or invention of new results)
Communication (the transmission of mathematical knowledge)
Intellectual challenge (the self-realization/fulfillment derived from constructing a proof)

A variable that the research deals with are the level of proof of pre-service teachers. The data obtained from the research were analyzed descriptively with a rubric prepared according to the proof levels in the study of Knuth et al. (2009). Detailed information about these levels is given in Table 2.

Table 2. Categories of levels of proof

Levels	Indicators
Level 0	Writing mathematical statements that are not intended to generalize or accept the accuracy of the given statement without any explanation
Level 1	Verifying the proof by using extreme (special) cases in the mathematical proof process
Level 2	Writing generalizing but mathematically inappropriate statements and incomplete proofs
Level 3	Evidence acceptable to authorities

The data obtained from the teacher responses were expressed as frequency/percentage values under categories. Since this study is qualitative since the sample was not chosen to represent the population, statistical generalization was not made; instead, the findings were evaluated to explore the examined subject in depth. The researchers stated that the names and information of the pre-service teachers would not be shared with anyone. As a result of the research, it was stated that the codes would be used instead of the participants' names in the article (P1, P2, P3, P4). In addition, for the research's validity, the pre-service teachers' views were included with one-to-one quotations. Overall, through an analysis of the data collected, this study aims to answer the following research questions:

- Which subject do pre-service mathematics teachers find most appropriate to prove?
- What subject of proof remains in the minds of pre-service mathematics teachers the most?
- What function of proof remains in the minds of pre-service mathematics teachers the most?
- What level of proof remains most in the minds of pre-service mathematics teachers?
- What is the reason why pre-service mathematics teachers preferring to prove?

Results

This study aims to examine the subject that pre-service teachers find most appropriate to prove, the function of proof that remains in their minds the most, and the reasons for preferring proof. In this context, the findings obtained in accordance with the sub-problems determined within the scope of the study are presented respectively. The answers given by the participants to the questions were first analyzed in the context of the topics. Table 3 contains data on the subjects that pre-service teachers find most appropriate to prove.

Table 3. Topics where proof is preferred

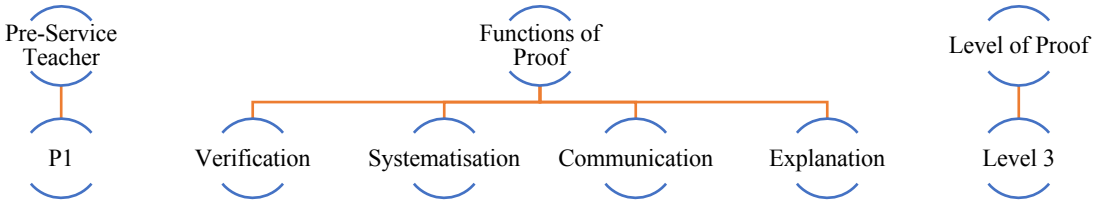
Topics preferred for proof	f (%)
Trigonometry	4 (100)
Derivative	3 (75)
Integral	2 (50)

According to the data in Table 3, pre-service teachers prefer proving trigonometry within the scope of analysis one and two courses. Derivative and integral subjects, which are among the subjects of the analysis course, are also among the subjects that are suitable for proof. Three pre-service teachers answered derivative, and one student answered integral. In Table 4, it is given which subject the proof belongs to the most in the minds of the pre-service teachers.

Table 4. The subject of the proof that remains in the minds of the pre-service teachers the most

Topics preferred for proof	**f (%)**
Trigonometry	4 (100)
Other topics	0 (0)

According to the data in Table 4, when the proof that the pre-service teachers most remembered was examined, it was determined that all answers were about trigonometry. Below, the images of the most common proofs in pre-service teachers' minds were presented, and the functions and levels of these proofs were examined. These functions were determined according to the categories de Villiers (1990) stated in his study. In the content of the table, information is also given about the level of proof made by pre-service teachers. Proofs of pre-service teachers were categorized according to the levels determined by Knuth et al. (2009). The most memorable proof of the pre-service teacher (P1) was shown in the figure below, then the functions and level of this proof were presented in Category 1.



Category 1. Function and level of proof of participant P1

The first participant preferred a general explanation regarding the accuracy of the statement made. Immediately afterwards, the participant followed the step of organizing the various results into a deductive system consisting of axioms, basic concepts, and theorems. In the next step, the participant attempted to transfer mathematical knowledge. While doing these, the participant tried to prove why it was correct by using visuals. The participant's solution process is presented below.

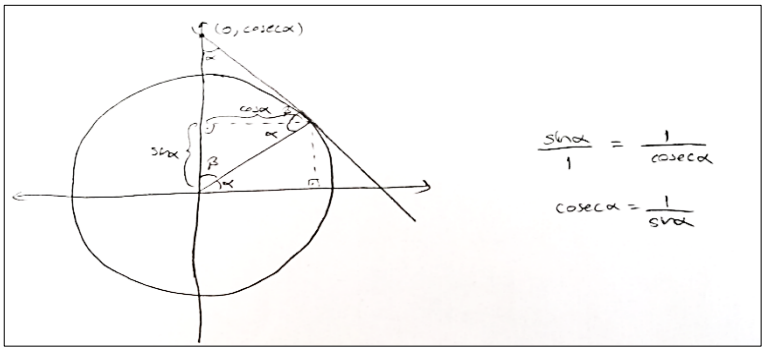
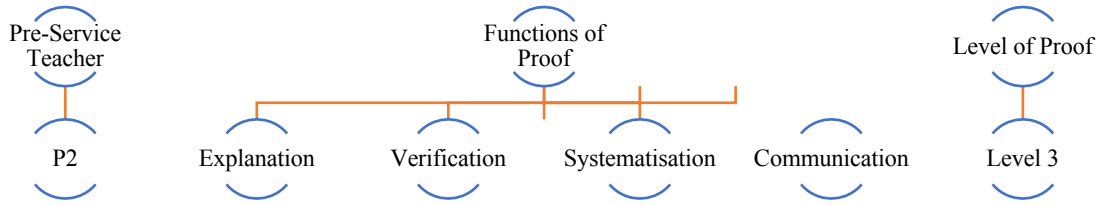


Figure 1. The proof that the pre-service teacher-P1 remember the most

The proof that pre-service teacher P1 remembered the most was the subject of trigonometry. P1 proved the expression of the cosecant function as a 1/sine function on the unit circle. While making this proof, he also benefited from the similarity in triangles. This proof included verification, systematization, communication, and explanation. In addition, when examined in terms of proof level, it was determined that it was the highest level (level 3) of proof. Because in this proof, a proof accepted by the mathematical authorities of a trigonometric function was made using mathematical connections. In the continuation of this study, pre-service teachers were asked to complete the sentence, "I preferred this proof because ..." regarding the reasons for choosing the proof that remained in their minds the most. Moreover, the reasons why pre-service teacher P1 prefer proof are given below.

"I preferred this proof because it provides a better understanding of the basics rather than memorization. I've always memorized the cosec function as the multiplicative inverse of the sine function until now. When I said the cosec function, I always thought of the 1/sine function, but I didn't know why. I learned the reason for this in the lesson on the unit circle and a more meaningful learning took place for me. Thus, I learned how to obtain a formula that I memorized, and this proof remained in my mind. The important thing is not to memorize, but to learn meaningfully. When I'm a teacher, telling my students to "memorize the formulas" is an easy, but not effective, method. Instead, explaining which formula came from where and how provides students with more permanent learning. At the same time, they can have a positive attitude towards the mathematics lesson."

The most memorable proof of the pre-service teacher (P2) was shown in the figure below, then the functions and level of this proof were presented in Category 2.



Category 2. Function and level of proof of participant P2

The second participant also preferred to explain where a generally accepted formula came from in his proof. The participant took care to act within a process while using the formula. In this process, the participant used a visual approach-based theorem proof and reached the conclusion through a gradual process. At the same time, the participant also benefited from his previous mathematical knowledge. The participant tried to prioritize mathematical knowledge, but this remained limited. While using mathematical knowledge, the participant preferred the visualization method and tried to prove it. The participant tried to support what the formula expressed with a visual. The participant's solution process is listed below.

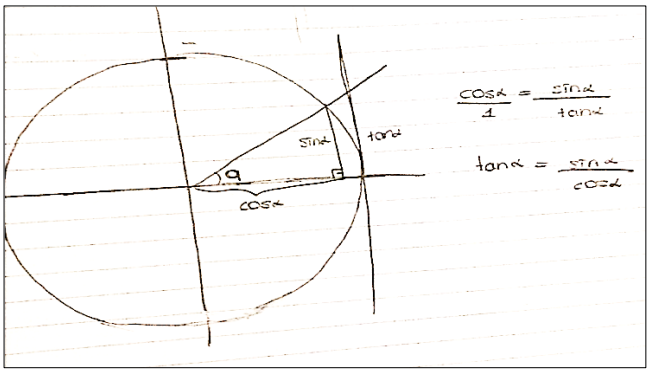


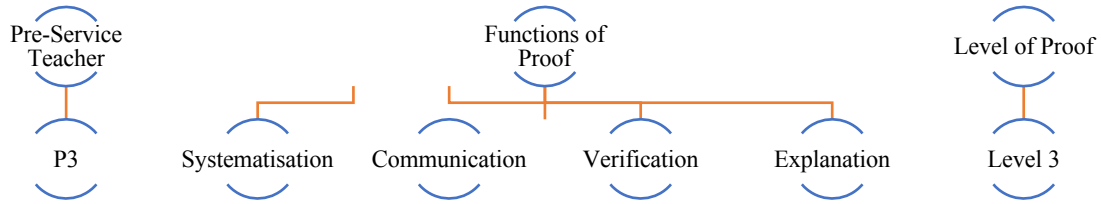
Figure 2. The proof that the pre-service teacher-P2 remember the most

The proof that pre-service teacher P2 remembered the most was again about trigonometry. P2 proved the proof of writing the tangent function as the ratio of the sine and cosine functions on the unit circle. While doing this proof, s/he obtained a ratio by using the similarity in triangles. This proof included verification, systematization, communication, and explanation. In addition, when it is examined in terms of proof level, it has been determined that it is proof at the highest level. In this proof, it was stated how a well-known trigonometric ratio formula is obtained by using mathematical connections. For this reason, it has been determined that this proof is level 3. The pre-service teacher (P2) was also asked why s/he preferred this proof, and s/he gave the following answer.

"I preferred this proof because it allows thinking about the basis of that knowledge, not memorizing it. One of the most frequently used formulas in trigonometry is the tangent function. The tangent function is given not only as a slope, but also as a sine/cosine function. And so far, all my math teachers have said

that the tangent function is equal to sine/cosine, but they didn't say why. I memorized this ratio as my teachers told me. But later I saw that this formula had a very simple proof on the unit circle, and so it stayed in my mind. Now it made more sense for me when I said sine/cosine to the tangent function. Now, when the tangent function is called, it makes more sense for me mathematically. Otherwise, I was saying sine/cosine, but saying that doesn't mean I understand the concept of tangent. On the contrary, it only shows that I learned superficially. The purpose of learning is permanent learning. Now I feel more confident in trigonometry subjects."

The most memorable proof of the pre-service teacher (P3) was shown in the figure below, then the functions and level of this proof were presented in Category 3.



Category 3. Function and level of proof of participant P3

The third participant explained a trigonometric formula using another trigonometric ratio and proved where this explanation came from. While doing this, care was taken to act within a certain system. The participant used visual and algebraic representations here and also explained how he identified similar triangles as a prerequisite before doing the proof. While doing this, the participant tried to explain his proof by using visuals. The participant's solution process is listed below.

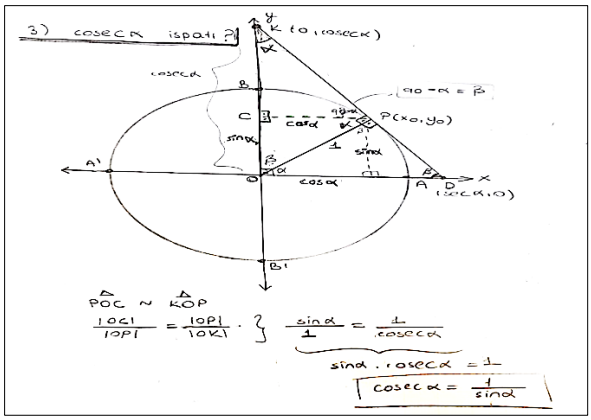


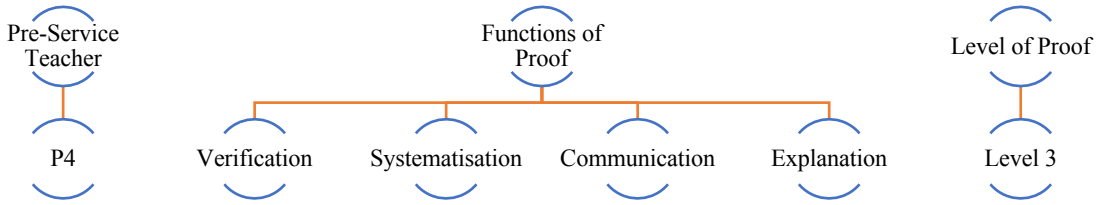
Figure 3. The proof that the pre-service teacher-P3 remember the most

As with the other participants, the proof that pre-service teacher P3 had the most in mind belonged to the subject of trigonometry. P3 proved the proportional formula of the cosecant function. Pre-service teacher P3 preferred to prove the cosecant function, like pre-service teacher P1. As can be seen from the answers, it was seen that the candidate numbered P3 made a more ample proof and wrote the data about the theorem more comprehensively. This proof includes verification, systematization, communication, and explanation. In addition, when examined in terms of proof level, it was determined that it was proof at the highest level. This proof clearly stated mathematical connections and how a commonly used ratio was obtained were expressed. For this reason, it has been determined that this proof is level 3. The pre-service teacher (P3) was also asked why s/he preferred this proof and s/he replied as follows.

"I preferred this proof because it provides meaning rather than memorization The Cosecant function is always expressed as a 1/sine function. I memorized it this way, without questioning why. Then I saw that this proof could be made by making use of the similarity theorem. Maybe I couldn't have done this proof by myself, but after seeing it that way in class, it stuck in my mind. Learning trigonometric formulas with their proofs provided me with a much more permanent learning process. I think I will be more successful

if I learn all math topics and formulas like this. For example, normally it is difficult for me to prove, but even proving is easy when I learn meaningful and step-by-step. At the very least, proof has been a tool for meaningful learning for me. Proving for trigonometry is meaningful, I hope I can have such a meaningful learning process for other courses and subjects."

The most memorable proof of the pre-service teacher (P4) was shown in the figure below, then the functions and level of this proof were presented in Category 4.



Category 4. Function and level of proof of participant P4

The fourth participant, unlike the other participants, did not prefer to use the unit circle in his proof. The participant did not prove a trigonometric formula, but a derivative of a trigonometric formula. While performing this proof, the participant benefited from his prior learning and different applications on derivatives (chain rule). At the same time, the participant also used trigonometric relations in the right triangle and expressed them visually. While making his statements, the participant tried to act in a certain order and tried to use all the components together to present his proof. The participant's solution process is listed below.

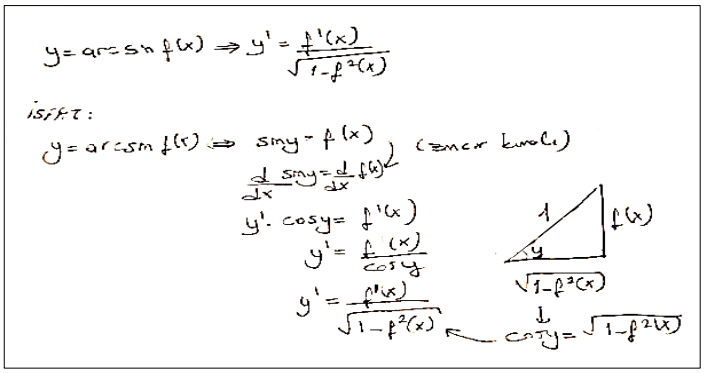


Figure 4. The proof that the pre-service teacher- P4 remember the most

The proof that the pre-service teacher P4 remembered the most was the subject of trigonometry, as was the case with the other participants. Here, the derivative formula of an inverse trigonometric function was proved instead of an essential trigonometric relation. Pre-service teacher P3 also benefited from the Pythagorean theorem while proving. This proof included verification, systematization, and communication functions. The function "Exploration of the meaning of a definition or the consequences of an assumption "is not included in this proof. Because here, a proof of a formula was made instead of a definition or a well-known ratio. Unlike a general trigonometric ratio in the proofs of pre-service teachers P1, P2, and P3, this proof included the derivative relation. It has been determined that this level of proof is the highest as in other proofs. In this proof, it was expressed how a commonly used formula was obtained by specifying mathematical equations. For this reason, it was coded as level 3. The pre-service teacher P4 was asked why s/he preferred this proof, and the following answer was obtained from his/her.

"I preferred this proof because it helps me understand a formula that is hard to memorize. Actually, the formulas of inverse trigonometric functions have always been more difficult for me. But now I understood the derivative formula of the arcsine function more clearly and this proof stuck in my mind. Thus, I learned a formula not as a pattern, but by knowing where it came from. And as such, inverse trigonometric functions and their derivative calculations have become more meaningful to me. What I expect from my teacher is to tell me where a formula comes from in the easiest way possible. The formulas that I just

> memorized without understanding the reason caused me to have a negative attitude towards mathematics and sometimes I was afraid of mathematics lessons. Or I just memorized formulas to pass the exam. Now I see that it wasn't that hard to actually learn meaningful. I don't know if I can learn every subject like this, but it made me very happy to prove something that I thought difficult..."

As can be seen in Figures 1, 2, 3 and 4, the proofs that pre-service teachers remember the most were about trigonometry. All participants provided proof of trigonometry. In the proofs of the pre-service teachers, in addition to the verification, explanation and communication functions of the proof, "systematization and exploration of the meaning of a definition" functions were also identified. In addition to the verification, explanation, communication and systematization steps, the exploration of a defined function's meaning is frequently used in proofs for trigonometric concepts (for example, cosecant, tangent), was observed. It was possible to see this function in the proofs of pre-service teachers P1, P2, and P3. In addition, pre-service teachers P1, P2, and P3 used the unit circle in their proofs. Pre-service teachers P1 and P3 preferred to prove the expression 1/sine(x), which is the rule of the cosecant function. The pre-service teacher P2, on the other hand, explained how to find the sine/cosine ratio, which is an expression of the tangent function on the unit circle. They also stated these by citing the similarity theorems on the unit circle. Pre-service teacher P4 preferred to prove the derivative of a function. The P4 pre-service teacher also preferred the inverse of the sine function, a trigonometric function. P4 proved where the derivative formula of the arcsine function came from; s/he also used different theorems in the triangle in this proof. Moreover, thus s/he proved where the rule of the arcsine function comes from.

When the proving levels of the pre-service teachers were examined, the proving levels of the pre-service teachers P1, P2, P3 and P4 were determined as the 3rd level. Because all of the proofs in this study were highly cognitive proofs accepted by mathematical authorities, in these proofs, the cognitive basis of each proof was presented by making use of similarity in triangles, unit circles or different theorems in triangles. In the interviews with the pre-service teachers, they expressed their proof verbally with their support and gave the necessary arguments. In the continuation of this study, pre-service teachers were asked to complete the sentence, "I preferred this proof because ..." regarding the reasons for choosing the proof that remained in their minds the most. A common theme was determined in the answers of the pre-service teachers P1, P2, P3 and P4. This theme was that they wanted to avoid memorizing while learning mathematics. When the answers of all pre-service teachers were examined, it was seen that they generally used the word memorization and preferred to prove instead of memorizing. All the proofs in this work were on a trigonometric ratio given as a formula or on explaining a formula. However, pre-service teachers proved where these formulas came from with scientific grounds. They also stated that the reason they preferred proof was that they did not want to memorize it. In addition, it was seen that the reasons given by the pre-service teachers for preferring proof were in accordance with the function of proof. In this respect, harmony was observed between the functionality of the pre-service teachers' proofs and the reason for preferring these proofs.

Conclusion and Discussion

This study examined the subject that the pre-service teachers find most suitable to prove, the function of the proof they remember the most, and the reason for choosing this proof and their proof level. In the findings section, when the subjects that the pre-service teachers found most suitable for proving were examined, trigonometry, derivative and integral subjects were preferred, respectively, according to the number of answers the participants gave. At this point, the pre-service teachers found it appropriate to prove the concepts of trigonometry, derivative and integral, which are the main subjects of the analysis course. All of the pre-service teachers in this study answered trigonometry in the first place for the subject they found most suitable for proving. All pre-service teachers who participated in the research agreed on trigonometry in connection with the fact that the subject of trigonometry contains many formulas.

Within the scope of the current study, a similarity was also found between the subject of proof that the pre-service teachers remember the most and the topics that they find the most appropriate to apply proof. Trigonometry was again the subject of proof that the pre-service teachers remembered the most and the subject they were most suitable for

proving. The fact that the most memorable proof and the subject suitable to be proved are similar can be expressed holistically with both permanence and causality principles. In addition, the most memorable proof about trigonometry can be explained by the fact that pre-service teachers were familiar with trigonometric formulas at the elementary school level and frequently encountered proofs on trigonometry in general. In that case, for pre-service teachers to prove about a subject and provide permanent learning with proof, preliminary knowledge about the subject should be sufficient. In different studies, pre-service teachers were asked to prove certain theorems on certain subjects, and as a result, it was concluded that pre-service teachers were insufficient in proving (Almeida, 2000; Jones, 2000; Moralı et al., 2006; Stylianides & Stylianides, 2023; Urhan & Bülbül, 2016; Weber, 2001). However, in this study, the subject/theorem to be proved was left to their preferences, without any subject or theorem orientation to the pre-service teachers.

Moreover, it was seen that all pre-service teachers participating in the research made proof within the scope of the analysis course. The pre-service teachers' proving proficiency in this study is different from other studies because the pre-service teachers have sufficient prior knowledge about the subject they prefer to prove. Mathematics is a reason-based science, so proof-making is very important in mathematics. However, it is seen that many teachers need more content knowledge on this issue, which constitutes the logical foundations of proof (Healy & Hoyles, 2000; Knuth, 2002; Martin & Harel, 1989). In that case, the prerequisite for students and pre-service teachers to succeed in the proof is sufficient prior knowledge of mathematical concepts and subjects. However, this situation should only be considered a prerequisite in proof with generalization because general mathematics achievement differs from having sufficient content knowledge about proof (Jones, 1997). According to the research results, although the prerequisite for making proof is mathematical prior knowledge and success, proving and mathematical success are separate parameters. Mathematical success and prior knowledge can only be seen as prerequisites in proving.

As a result of the research, it was another remarkable finding that the proof that remained in the minds of the pre-service teachers mainly consisted of visual proofs. In that case, it would be beneficial to increase the visual representations in the teaching content, including the visual proofs, to ensure permanent and meaningful learning. In different studies in the literature, the effect of the stimuli factors in the learning environment on the learner's permanent learning has been revealed (Angelides & Agius, 2002; Botana & Valcarce, 2002; Strijbos et al., 2003). A similar result in this study regarding the importance of visual proof was obtained in another study, and it was stated that visual proof provided a better learning experience (Polat & Akgün, 2023). In other words, the importance of visual proof has been reinforced with this study. In the proofs of the pre-service teachers, in addition to "the verification, explanation and communication functions of the proof, systematization and exploration of the meaning of a definition", functions were also identified. Schoenfeld (1994) states that in traditional teaching environments, the explanatory power of proof is not utilized in favor of students. Therefore, students need help to capture the depth of thought inherent in proof. Another essential role of proof in mathematics education is that it enables sharing of information and ideas; that is, it functions as a communication tool. As mentioned in the previous section, many mathematics educators define proof as a social activity that allows sharing of ideas between individuals (Hanna, 1990) and as a product of the mathematics learning-teaching process (Wheeler, 1990). In the proof process, it is clear that a cognitive-based but predominantly social communication and interaction process takes place.

For this reason, mathematics educators define proof as a social activity and a product of the learning-teaching process and emphasize its contributions to individuals in this respect. As a result of this research, it was seen that the generally accepted formulas on trigonometry and derivatives were expressed clearly with proof. Indirectly, expressions, ratios and formulas, widely used in mathematical language, are explained by making them more understandable with proof. In this respect, the proofs used by pre-service teachers contribute to them in terms of mathematical language. As another parameter in the research, the pre-service teachers' proof level was examined. In many studies in the literature, it has been determined that students are inadequate in proving (Jones, 2000; Morris, 2002; Raman, 2003; Stylianides & Stylianides, 2023; Urhan & Bülbül, 2016; Weber, 2001). Based on these results, the proof levels of pre-service teachers within the scope of this study were at a high level, unlike the studies in the literature. When the proofs of the pre-service teachers in the study were examined according to the four different levels suggested by Knuth et al. (2009), it was determined that

all the proofs were logical and holistic depending on the cognitive bases, and it was seen that all the proofs were level 3, which is the highest level. Based on this, it can be said that contrary to the common belief that pre-service teachers' achievement levels in proving are low, their proof levels will be high if there is sufficient prior knowledge. The studies conducted by Martin and Harel (1989) and Stylianides et al. (2007) with pre-service teachers revealed that pre-service teachers verified propositions/theorems by using exceptional cases instead of proofs, and they could not use mathematical language correctly. One of the main reasons for this situation may be the teaching methods used in the lessons. The traditional method follows the order of definition, theorem and proof. However, studies have revealed that peer interaction and in-group discussions increase students' proving skills (Sarı-Uzun & Bülbül, 2013; Weber et al., 2008). The researchers who carried out this study also emphasized the proof of formulas and rules commonly used within the scope of analysis 1 and 2 courses. In addition, they showed trigonometric formulas on the unit circle and taught derivative formulas based on cognitive bases, away from memorization. The fact that the pre-service teachers participating in this research have a high level of proof can be explained in connection with this situation. It can be said that teaching a proof-based and rote-free course in a course increases students' ability to prove themselves. From this point of view, it can be said that preparing course content based on proof and cognitive bases will provide students with a meaningful learning process instead of memorization.

In the continuation of the study, one more question was asked to the participants. The pre-service teachers completed the sentence "I preferred this proof because ..." about the proof that remained in their minds the most, and it was seen that the reason they stated was suitable for the function of the proof they made. All pre-service teachers wrote that it provides meaningful learning instead of memorization as the reason for preferring the proof they have done. The fact that all the proofs preferred by the pre-service teachers contain a formula also confirms a meaningful learning desire instead of memorization. All pre-service teachers preferred to make proof about trigonometry. However, they said they were prejudiced about trigonometry before and just memorized the formulas without making sense of them. Pre-service teachers P1 and P3 proved the cosecant function; they benefited from the similarity theorem in triangles even though they used different visuals. Moreover, they stated they needed to learn why the cosecant function was previously expressed as 1/sine. They also developed a positive attitude towards trigonometry subjects when they learned this proof in the analysis class. Pre-service teacher P2 also proved why the tangent function is equal to sine/cosine. Moreover, he said that he could now prove the tangent as a meaningful formula, not just a memorized ratio, as the reason for choosing this proof. Even though the pre-service teacher P4 chose trigonometry again, s/he proved the derivative of an inverse trigonometric function instead of an essential trigonometric relation. Like the other participants, pre-service teacher P4 emphasized the importance of basic formulas meaningfully rather than memorizing them. S/he stated that this meaning-making process is related to the way of learning in the lesson. Therefore, when the answers of all pre-service teachers are examined, a vital result emerges. Students having an effective learning process and a high level of proof skill depend on how and how and how the subjects are taught. In other words, teachers' teaching methods in the lesson can also affect the quality of their students' learning products. A similar result was obtained in a different study, and the importance of teacher training was emphasized. A similar result was obtained in a different study, and it was stated that improving the role of proof in school mathematics would require teachers' learning (Lesseig, 2016). A similar result was obtained in a different study, and it was stated that improving the role of proof in school mathematics would require teachers' learning. As stated in the literature, the development of student abilities lies in teachers creating opportunities for students to develop these abilities. (Bieda, et al., 2014; Cai & Howson, 2012) A different study in the literature revealed that when pre-service teachers were asked to "prove or show that it is true, " they did not question or have knowledge about proof methods (Demircioğlu, 2023, p. 330). In this study, pre-service teachers proved the basic formulas and stated their reasons for preferring this proof by the function of the proof. In that case, the ability of students to prove can be directly related to how the basic formulas and contents presented in the course are taught.

The findings of this study were obtained from the analysis of 1 and 2-course topics. Conducting similar studies on other subjects within the scope of mathematics will contribute to expanding the results of this research. Another suggestion obtained according to the results of this study is the necessity of emphasizing the proof processes in the course

contents to increase the pre-service teachers' level of proof. The researchers in this study presented intense content for the proof of the formulas and theorems in the course content. This situation has also improved their students' success towards proof. In this respect, it is essential to emphasize the processes of making proofs in the course contents and to explain the formulas and theorems with scientific relations. In particular, educators who teach trigonometry subjects can achieve more permanent learning by using the properties of the unit circle and similarity theorems. In this context, in order to be able to do advanced mathematics, learning environments and proof activities that enable pre-service teachers to see their deficiencies and mistakes should be included.

Recommendations

Recommendations for Researchers

The findings of this study were obtained from the analysis of 1 and 2-course topics. Conducting similar studies on other subjects within the scope of mathematics will contribute to expanding the results of this research. For researchers who want to research proof-making skills, it can be recommended to conduct experimental studies because teaching processes are critical in students' proof-making skills. Examinations on the types of proof can be added to the subject of research in this field, and it can be examined which type of proof is preferred by students. Determining which subjects and theorems students have difficulty proving can be recommended for additional learning on these subjects. In addition to all these, the relationship between the variables that are thought to affect the ability to prove and proof can be investigated. Moreover, studies that reveal the increase in students' proof-making skills with the teachers at various education levels allocating time to proof in the lessons will emphasize the importance of proving in mathematics teaching.

Recommendations for Practitioners

In light of the findings of these studies, more sensible suggestions can be made to improve pre-service teachers' knowledge systems and classroom teaching on proof. Another suggestion obtained according to the results of this study is the necessity of emphasizing the proof processes in the course contents to increase the students' pre-service teachers' level of proof. The researchers in this study presented intense content for the proof of the formulas and theorems in the course content. This situation has also improved their students' success towards proof. In this respect, it is essential to emphasize the processes of making proofs in the course contents and to explain the formulas and theorems with scientific relations. In particular, educators who teach trigonometry subjects can achieve more permanent learning by using the properties of the unit circle and similarity theorems. In this context, in order to be able to do advanced mathematics, learning environments and proof activities that enable pre-service teachers to see their deficiencies and mistakes should be included.

The most important limitation of the study is that only analysis 1 and analysis 2 course topics are included in the questions asked to pre-service teachers about proof. Theorems and formulas in the Analysis 1 and 2 courses were taught to the pre-service teachers who participated in the research, and their proofs by the researchers who attended this course. For this reason, different results can be obtained in different participant groups in which different teaching methods are applied. The research is limited to pre-service teachers' questions and answers. Another limitation of the study is that only volunteer pre-service teachers participate in the research. The answers to the research questions may differ according to the pre-service teachers at different grade levels. Therefore, the opinions of pre-service teachers who did not participate in the study or did not want to participate may differ. Thus, the same study can be used with different sample groups.

Limitations of Study

This research is limited to the mathematical proofs answered by the pre-service teachers who participated in the research. In terms of the study group, it is limited to four pre-service teachers who voluntarily participated in the research in the 2021-2022 academic year.

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Research Article

Classroom teachers' self-efficacy regarding gifted education

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Abstract

The aim of the study is to examine the self-efficacy of classroom teachers towards gifted education in terms of different variables. A total of 252 classroom teachers, 150 female and 102 male, working in Osmaniye province and its districts in the south of Turkey in the 2022-2023 academic year, participated in the study. In order to determine the demographic characteristics of the participants, the "Personal Information Form" prepared by the researcher and the "Self-Efficacy Perception Scale for Teachers Regarding the Education of Gifted Individuals" consisting of six sub-dimensions developed by Tortop (2014) were used. While analysing the data; frequency and percentage values, independent samples t-test and one-way analysis of variance (ANOVA) were used for the demographic information of the participants. According to the results obtained, no statistically significant difference was found in terms of professional seniority in the self-efficacy levels of classroom teachers towards the education of gifted students. However, it was determined that there was a significant difference in the personality trait sub-dimension in favour of male teachers in terms of gender variable of classroom teachers. It was found that there was a significant difference in the academic and planning sub-dimensions and the total scale in favour of teachers with postgraduate education in terms of the educational status of the classroom teacher. It was found that there was a significant difference in the counselling and planning sub-dimensions of the scale in terms of nominating students to Science and Art Center (SAC). It was found that there was a significant difference in the direction of high self-efficacy in terms of having a student diagnosed as gifted in the classroom, teaching in the support room and receiving in-service training or courses for gifted students. Some suggestions were made by considering the findings obtained as a result of the research.

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Introduction

The concepts of cognition, intelligence and mind have been analysed and defined from different aspects by many experts from past to present. Binet defines intelligence as the ability to make the right decision, the capacity to constantly surpass oneself and good reasoning skills. According to Weschler, intelligence is a mental capacity that includes logical thinking, purposeful behaviour and being in active relationship with the environment (as cited in San Bayhan & Artan, 2005). Samurçay (1983), based on different definitions of intelligence, stated that the following points about intelligence can be taken as a basis: The ability to learn new information quickly; The ability to understand and use the relationships between abstract expressions and symbols; The ability to discover new concepts in a mixed state; The ability to focus ideas on a certain point; The ability to control and criticise different information.

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Intelligence is associated with characteristics such as problem solving ability and easy adaptation to different stimuli. It has been used for hundreds of years to express the general mental capacity of individuals. When the past definitions of the concept of intelligence are analysed, individuals whose intelligence levels are measured and whose general intelligence capacities are above a certain limit are referred to as high intelligence or gifted individuals. The concept of giftedness is not limited to having high potential in general intelligence tests. For this reason, the concept of "gifted" is preferred today instead of "gifted" (Özbay, 2013).

The concept of giftedness has been defined differently from past to present and different approaches have been obtained as a result. Terman (1925) defined giftedness as the top 2% of individuals who scored the highest in standard intelligence tests applied to individuals. It was observed that Terman used only intelligence as a criterion to explain giftedness. In the new models proposed in the following periods, the concept of giftedness was analysed in multiple dimensions. One of the first known multi-dimensional models is Renzulli's model. Renzulli's definition of giftedness is one of the most widely accepted definitions today. Renzulli (1986) based giftedness on three basic elements, namely task responsibility, creativity and talent, based on his three-ring model. Another model that defines the concept of giftedness is Tannenbaum's (1986) starfish model. According to the starfish model, a person must have five factors in order to be gifted. Each factor is not sufficient on its own; in other words, the combination of four factors does not make sense without the fifth factor. The five factors in Tannenbaum's starfish model are: luck, special talent, general talent, non-intellectual (non-intelligence-related) characteristics and environmental factors (as cited in Sürmeli, 2015). When different approaches to giftedness are analysed, it is seen that at first only intelligence was taken as a criterion, but as we get closer to the present day, other factors are also mentioned. Apart from intelligence, it can be said that one of the factors that should be emphasised is education. In order for gifted individuals to receive appropriate education, they must first be diagnosed.

In the identification of gifted students in Turkey, the application and nomination process, testing of the nominated individuals, and making decisions about the individuals according to the test results are followed in order (Sak, 2010). In the identification process of gifted students in Turkey, the principles specified in the Science and Art Centres Directive are taken into consideration. Science and Art Centres (SAC) are the most common institutions providing education to gifted individuals. In these institutions, it is aimed to provide services to gifted individuals outside the school hours within the framework of the determined programme (Kaya, 2013). The Ministry of National Education of Türkiye (MoNET) determines the grade level and age of identification of the candidates. Considering these criteria, students who are thought to be gifted in at least one of the areas of music, visual arts and general mental ability are nominated in accordance with the published guidelines (MoNET, 2016). Teachers have a great role in the correct nomination of gifted students and the effectiveness of the education to be given to them.

Since it is important for gifted children to be recognised at an early age and educated in line with their abilities in order for them to become people who are beneficial to society, the characteristics that classroom teachers should have come to the fore. Classroom teacher can be defined as a person who transfers the achievements of the subjects in the education programmes in primary schools to children and supports children's sociable, creative, research-loving, positive attitudes towards themselves and the environment they live in, and their ability to communicate well with others (Tok & Bozkurt, 2010). Teachers who will teach gifted students should have richer imagination and be more talented individuals than other teachers (Lewis, 1982). The characteristics that classroom teachers should have can be classified under two headings as "personality and professional" characteristics (Şahin, 2012). Personality characteristics of teachers can be listed as being patient and a good listener, having a strong sense of self, being aware of the interests and needs of students, supporting the development of the child, motivating the student for learning, being open to criticism, having the ability to work systematically, making an effort to keep the student active in the learning process, reacting consistently to the events encountered, looking at the events holistically and without prejudice (Dağlıoğlu & Metin, 2004; Sak, 2010). Professional characteristics of teachers can be listed as having a good command of teaching methods and techniques, knowing the concepts of giftedness, recognising the affective characteristics of gifted children, and having the potential to maximise students' thinking skills (Chan, 2001; Dağlıoğlu & Metin, 2004; Sak,

2010). The fact that classroom teachers have adequate professional equipment directly affects their self-efficacy in the education of gifted children.

Bandura (1986) defines self-efficacy as an individual's judgement about the level of successful realisation of the related activities by planning in order to reach a certain level of success. Bandura (1994) bases self-efficacy on four interrelated basic knowledge. These are: performance achievements, emotional state, indirect experiences as a result of others' experiences and verbal persuasion. Bandura (1995) states that the most effective of these four basic knowledge is performance achievements. The success obtained as a result of the individual's experience motivates his/her future behaviours positively. Based on the results of the research, it is possible to say that teachers with high self-efficacy levels successfully carry out activities in the education process (Kiremit, 2006).

It is seen that there are many studies on teachers' self-efficacy. In their study, Korkut and Babaoğlan (2012) found that self-efficacy of classroom teachers can differ according to gender and school location. Similarly, it is among the studies that there are significant differences in teachers' self-efficacy on issues such as technology acceptance and professional seniority (Aktürk & Delen, 2020). Barni, Danioni, and Benevene (2019) showed in their study that teachers' conservation values have a positive relationship with the sense of self-efficacy regardless of the type and level of motivation to teach, and they found that the relationships between openness to change and self-efficacy, as well as altruism and self-efficacy, vary depending on teachers' motivation. In this context, considering the effect of teachers' self-efficacy on children, it is important to determine what kind of self-efficacy they have towards gifted students.

It is difficult for a teacher to have all of the above-mentioned characteristics. However, the classroom teacher's competence in the subject plays an important role in the correct identification of gifted children and their receiving a good education. In addition to achievement tests, teacher evaluations are taken into consideration in identifying gifted children, because it is unlikely that a classroom teacher will overlook the existence of a gifted child who is working below his/her potential. Teachers are in a position to observe certain behavioural correlates of intellectual giftedness in their daily interactions with children (Borland, 1978). As of the 2021-2022 academic year, the Ministry of National Education of Türkiye has regulated the number of nominations for gifted students to be 20% of the student body. This situation reveals the importance of the nomination process of gifted students to SAC, which is the first step of the identification phase of gifted students, and the competencies of classroom teachers who carry out their basic education on gifted students.

Although classroom teachers are important elements in the identification and education of gifted children, there is not much research on whether they have sufficient potential for gifted education, which reveals the importance of conducting this study. In this study, which aims to examine the self-efficacy levels of classroom teachers towards gifted education in terms of different variables, answers to the following questions were sought;

- Do classroom teachers' self-efficacy towards gifted education differ significantly in terms of gender, professional seniority, faculty of graduation and educational status?
- Classroom teachers' self-efficacy towards gifted students' education at nominating of students to Science and Art Centre (SAC)?
- There are students diagnosed as gifted in the class or teaching in the support education room
- Is there a significant difference in terms of participation in in-service training or any course?

Method

Research Model

In this research, quantitative research method was used. In the research, relational screening was applied in order to determine the self-efficacy levels of classroom teachers and to reveal their relationships with various variables. The survey model is a research model that aims to determine a situation that has existed in the past or currently exists by describing it as it exists (Karasar, 2012).

Sampling

The population of the study is the classroom teachers working in Osmaniye province in the south of Turkey in the 2022-2023 academic year. A total of 252 classroom teachers, 150 female and 102 male, were selected from the population by random sampling method. In this type of sampling, all units in the population have an independent and equal probability to be selected for sampling (Büyüköztürk et al., 2009). Demographic information of the participants is given in Table 1.

Table 1. Demographic ınformation of the participants

Variable	Demographic Characteristics	Frequency (f)	Percent (%)
Gender	Female	150	59.5
	Male	102	40.5
Professional Seniority (years)	0-10	34	13.5
	11-20	128	50.8
	21 years and over	90	35.7
Graduated Faculty	Faculty of Education	226	89.7
	Other	26	10.3
Education Status	Undergraduate education	190	75.4
	Postgraduate education	62	24.6
Nomination status for SAC	At least one of the candidates won	104	41.3
	There were no winners among the candidates	103	40.9
	I did not nominate	45	17.9
The presence of gifted students in the class	Yes	40	15.9
	No	212	84.1
Providing courses to gifted students in the support education room	Yes	31	12.3
	No	221	87.7
Receiving in-service training or courses related to gifted students	Yes	80	31.7
	No	172	68.3

When Table 1 is analysed, it is seen that 59,5% of the classroom teachers are female in terms of gender. It is seen that the participants' seniority range is mostly between 11-20 (50,8%) years. According to the type of faculty graduated, it is seen that most of the graduates are education faculty graduates (89,7%). According to the educational status, it is seen that most of the graduates are bachelor's degree graduates (75,4%). According to the status of nominating a candidate for Bilsem; "I nominated, won 41.3%", "I nominated, did not win 40.9%", "I did not nominate 17.9%". 84.1% of the answers to the question of having gifted students in their class were no. 87,7% of the answers to the question about giving courses to gifted students in the support education room were no. It was concluded that 68,3% of the answers to the question of receiving in-service training or courses related to gifted students were no.

Data Collection Tools

The data were collected through Google Forms and the personal information form prepared by the researcher and the Self-Efficacy Scale for Gifted Education were used. In the personal information form, there are questions designed to collect information about classroom teachers' gender, professional seniority, graduated faculty, educational status, nomination to Science and Art Centres, whether there are gifted students in their class, in-service training and courses related to gifted education.

Self-Efficacy Scale for Gifted Education

The scale used to collect data in the study will be used to determine the self-efficacy of classroom teachers regarding the education of gifted students. This scale adapted and developed by Tortop (2014) consists of 26 items and six sub-dimensions. Factor analyses were performed on the scale and reliability coefficients were determined for sub-dimensions and the whole scale. The Cronbach Alpha reliability coefficients for the sub-dimensions and the whole adapted scale are as follows; Academic Qualification 0,86, Mentorship Qualification 0,93, Responsibility 0,77,

Personality Traits 0,91, Creativity Fostering Qualification 0,94, Instructional Planning Qualification 0,94 and 0,90 for the whole scale.

Data Analyses

The normality distributions of the scale filled out by the classroom teachers to determine their self-efficacy towards gifted education and the descriptive statistics of the scale are analysed in Table 2.

Table 2. Normality distributions and descriptive statistics distributions for the scale

Sub-factors	N	Min.	Mak.	Mod	Med.	$\overline{X}$	S	Skewness	Kurtosis
Academic Qualification	252	1	5	3	3	3.08	1.02	.022	-.628
Mentorship Qualification	252	1	5	3	3.25	3.12	1.03	-.163	-.534
Responsibility	252	1	5	3	3.33	3.25	.91	.061	-.289
Personality Traits	252	2.57	5	4	4	4	.64	-.211	-.751
Creativity Fostering Qualification	252	1.67	5	4	4	3.96	.72	-.412	-.144
Instructional Planning Qualification	252	1	5	4	3.66	3.57	.90	-.340	-.397
Scale Total	252	1.88	5	3.77	3.65	3.61	.67	-.110	-.348

When the normality distributions and descriptive statistics results of the responses of the classroom teachers to the scale were examined, it was found that the skewness and kurtosis scores showed a normal distribution between the limits accepted as normal between +1.50 and -1.50 (Tabachnick & Fidell, 2007). In line with the collected data, t Test was performed for two independent variables and One-Way Analysis of Variance was performed for more than two independent variables, and in case the variance analysis was significant, pairwise comparisons were checked with Post-Hoc: Bonferroni test was used.

Findings

Whether the scores of classroom teachers' self-efficacy scale and subscales related to gifted education differed according to gender was analysed by t-test and the results are presented in Table 3.

Table 3. T-test analysis results of classroom teachers' scale scores according to gender

Sub-factors	Gender	N	$\overline{X}$	S	Sd	t	p
Academic Qualification	Female	150	3.06	1.04	250	-.389	.698
	Male	102	3.11	.99			
Mentorship Qualification	Female	150	3.11	1.06	250	-.277	.782
	Male	102	3.14	1			
Responsibility	Female	150	3.26	.91	250	.341	.733
	Male	102	3.22	.91			
Personality Traits	Female	150	3.93	.67	250	-2.097	.037*
	Male	102	4.10	.58			
Creativity Fostering Qualification	Female	150	3.93	.73	250	-.916	.361
	Male	102	4.01	.70			
Instructional Planning Qualification	Female	150	3.50	.97	250	-1.451	.287
	Male	102	3.67	.80			
Scale Total	Female	150	3.58	.70	250	-1.066	.932
	Male	102	3.67	.62			

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to their gender, it was found that there was a statistical difference in the personality trait sub-dimension and the personality trait sub-dimension scores of male teachers ($\overline{X}$=4.10) were higher than the personality trait scores of female teachers ($\overline{X}$=3.93)

(p<0.05). This finding can be interpreted as male teachers' self-efficacy related to personality traits is higher than female teachers.

Whether the scores of the classroom teachers according to their professional seniority differed or not was analysed by ANOVA and the results are given in Table 4.

Table 4. ANOVA results of classroom teachers' scale scores according to professional seniority

Sub-factors	Professional Year	N	$\bar{X}$	S	Sd	F	p
Academic Qualification	0-10 year[a]	34	3.08	1.02			
	11-20 year[b]	128	3.05	1.04	2-249	.58	.944
	21 year and over[c]	90	3.10	1			
Mentorship Qualification	0-10 year[a]	34	3.18	1			
	11-20 year[b]	128	3.16	1.04	2-249	.395	.674
	21 year and over[c]	90	3.04	1.05			
Responsibility	0-10 year[a]	34	3.50	1.04			
	11-20 year[b]	128	3.24	.93	2-249	1.622	.200
	21 year and over[c]	90	3.17	.81			
Personality Traits	0-10 year[a]	34	4.10	.66			
	11-20 year[b]	128	4.03	.62	2-249	1.308	.272
	21 year and over[c]	90	3.92	.65			
Creativity Fostering Qualification	0-10 year[a]	34	4.13	.73			
	11-20 year[b]	128	3.97	.74	2-249	1.286	.278
	21 year and over[c]	90	3.90	.68			
Instructional Planning Qualification	0-10 year[a]	34	3.75	.94			
	11-20 year[b]	128	3.60	.92	2-249	1.530	.219
	21 year and over[c]	90	3.45	.86			
Scale Total	0-10 year[a]	34	3.74	.72			
	11-20 year[b]	128	3.63	.68	2-249	1.087	.339
	21 year and over[c]	90	3.54	.64			

The Anova test was used to analyse whether the scores of classroom teachers on the Self-Efficacy Scale for Gifted Education and subscales differed according to their professional seniority. As a result of the post-hoc multiple comparison technique "Bonferroni", no significant difference was found (p>0.05).

The t-test was used to analyse whether the scores obtained by the classroom teachers from the scales differed according to their educational status and the results are given in Table 5.

Table 5. T-test Analysis results of teachers' scale scores according to educational background

Sub Factor	Education Status	N	$\bar{X}$	S	Sd	t	p
Academic Qualification	Undergraduate	190	2,97	1.02	250	-2.801	.005*
	Postgraduate	62	3,39	.95			
Mentorship Qualification	Undergraduate	190	3,06	1.06	250	-1.553	.122
	Postgraduate	62	3,30	.93			
Responsibility	Undergraduate	190	3,21	.94	250	-1.014	.312
	Postgraduate	62	3,35	.80			
Personality Traits	Undergraduate	190	3,96	.67	250	-1.472	.142
	Postgraduate	62	4,10	.53			
Creativity Fostering	Undergraduate	190	3,92	.75	250	-1.503	.134
Qualification	Postgraduate	62	4,08	.60			
Instructional Planning	Undergraduate	190	3,50	.95	250	-2.134	.034*
Qualification	Postgraduate	62	3,78	.72			
Scale Total	Undergraduate	190	3,56	.70	250	-2.098	.037*
	Postgraduate	62	3,77	.55			

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to their educational status, it was found that there was a statistical difference in the total, academic and planning sub-dimensions of the scale ($p<0.05$). It was concluded that the mean scores of postgraduate education were higher than the mean scores of undergraduate education in the total scale and academic and planning sub-dimensions. This can be interpreted as classroom teachers with postgraduate education have higher levels of self-efficacy towards gifted students. In other sub-dimensions of the scale, it was found that there was no significant relationship according to educational status ($p>0.05$).

The ANOVA test was used to analyse whether the scores obtained by the classroom teachers from the scales differed according to the status of nominating a candidate to BİLSEM and the results are given in Table 6.

Table 6. ANOVA results of teachers' scale scores according to nomination status

Sub-factors	Nomination Status	N	$\bar{X}$	S	Sd	F	p	Difference
Academic Qualification	At least one of the candidates won[a]	104	3.28	1				
	There were no winners among the candidates[b]	103	2.95	1.05	2-249	3.668	.027	
	Not a candidate[c]	45	2.89	.90				
Mentorship Qualification	At least one of the candidates won[a]	104	3.08	1.02				
	There were no winners among the candidates[b]	103	3.36	1.01	2-249	4.873	.008*	a>b a>c
	Not a candidate[c]	45	2.98	1.12				
Responsibility	At least one of the candidates won[a]	104	2.90	.91				
	There were no winners among the candidates[b]	103	3.28	.91	2-249	.547	.579	
	Not a candidate[c]	45	3.18	.92				
Personality Traits	At least one of the candidates won[a]	104	3.34	.64				
	There were no winners among the candidates[b]	103	4.08	.66	2-249	1.380	.254	
	Not a candidate[c]	45	3.94	.60				
Creativity Fostering Qualification	At least one of the candidates won[a]	104	3.96	.69				
	There were no winners among the candidates[b]	103	4.05	.73	2-249	1.391	.251	
	Not a candidate[c]	45	3.89	.75				
Instructional Planning Qualification	At least one of the candidates won[a]	104	3.93	.89				
	There were no winners among the candidates[b]	103	3.73	.94	2-249	3.269	.040*	a>b
	Not a candidate[c]	45	3.41	.78				
Scale Total	At least one of the candidates won[a]	104	3.56	.68				
	There were no winners among the candidates[b]	103	3.74	.70	2-249	3.078	.048	
	Not a candidate[c]	45	3.52	.53				

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to the ANOVA test conducted on the status of having a candidate student in SAC, statistical significance was obtained in the total scale and academic, counselling and planning sub-dimensions ($p<0.05$). However, as a result of the "Bonferroni Test", which is one of the post-hoc multiple comparison techniques, it was concluded that there was no significant difference between the averages of the variables in the total and academic sub-dimensions of the scale. In the counselling and planning sub-dimensions of the scale, it was seen that there was a difference in favour of at least one of the nominated students winning in the case of teachers nominating students to SAC. From this point of view, it is possible to say that the self-efficacy levels related to counselling and planning dimensions are high according to the status of winning at least one of the students nominated to SAC.

According to the presence of gifted students in the classroom, the t-test was analysed to see whether the scores obtained by the classroom teachers from the scales differed and the results are given in Table 7.

Table 7. T-test results of teachers' scale scores according to the presence of gifted students in the classroom

Sub-factors	Student Presence	n	$\bar{X}$	S	Sd	t	p
Academic Qualification	There is	40	3.78	1.05	250	4.953	.000*
	None	212	2.94	.96			
Mentorship Qualification	There is	40	3.86	.95	250	5.136	.000*
	None	212	2.98	.99			
Responsibility	There is	40	3.35	.97	250	.797	.426
	None	212	3.23	.90			
Personality Traits	There is	40	4.39	.53	250	4.350	. 000*
	None	212	3.92	.63			
Creativity Fostering Qualification	There is	40	4.42	.57	250	4.460	.000*
	None	212	3.88	.71			
Instructional Planning Qualification	There is	40	4.12	.79	250	4.340	.000*
	None	212	3.46	.89			
Scale Total	There is	40	4.09	.60	250	5.146	.000*
	None	212	3.52	.65			

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to the presence of gifted children in their classes, it was found that there was a statistical difference (p<0.05). Accordingly, when it was examined between which two situations, it was found that the self-efficacy scores of teachers who had gifted students in their class were statistically significantly higher in all dimensions except the responsibility dimension (p>0.05).

The t-test was analysed to see whether the classroom teachers' scores on the scales differed according to whether they provided courses in the support education room for students diagnosed with giftedness, and the results are given in Table 8.

Table 8. T-test Results of the scores of teachers' providing courses to students diagnosed with giftedness in the support education room

Sub-factors	Gender	N	$\bar{X}$	S	Sd	t	p
Academic Qualification	Yes	31	3.63	1.15	250	3.280	.001*
	No	221	3.00	.98			
Mentorship Qualification	Yes	31	3.71	1.10	250	3.466	.001*
	No	221	3.04	1.00			
Responsibility	Yes	31	3.20	.99	250	-.314	.754
	No	221	3.25	.90			
Personality Traits	Yes	31	4.25	.62	250	2.323	.021*
	No	221	3.96	.64			
Creativity Fostering Qualification	Yes	31	4.19	.76	250	1.852	.065
	No	221	3.93	.71			
Instructional Planning Qualification	Yes	31	3.95	.95	250	2.543	.012*
	No	221	3.51	.89			
Scale Total	Yes	31	3.93	.74	250	2.790	.006*
	No	221	3.57	.65			

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to the teachers' giving courses to students diagnosed with giftedness in the support education room, a statistical difference was found in the total scale and Academic, Counselling, Personality Traits, and Planning dimensions (p<0.05). According to this result, it was found that the scores of the teachers who gave courses to the students diagnosed with giftedness in the support education room were significantly higher than the other teachers.

The t-test was used to analyse whether the scores of the classroom teachers on the scales differed according to whether they received in-service training or courses on giftedness and the results are given in Table 9.

Table 9. T-test results of the scores of teachers' receiving ın-service training or courses for gifted students

Sub-factors	Receiving Training	N	$\bar{X}$	S	Sd	t	p
Academic Qualification	Yes	80	3.65	.96	250	6.557	.000*
	No	172	2.81	.93			
Mentorship Qualification	Yes	80	3.68	.91	250	6.297	.000*
	No	172	2.86	.99			
Responsibility	Yes	80	3.38	.86	250	1.602	.110
	No	172	3.18	.93			
Personality Traits	Yes	80	4.25	.54	250	4.443	.000*
	No	172	3.88	.65			
Creativity Fostering Qualification	Yes	80	4.20	.61	250	3.531	.000*
	No	172	3.86	.74			
Instructional Planning Qualification	Yes	80	3.95	.78	250	4.681	.000*
	No	172	3.39	.91			
Scale Total	Yes	80	3.95	.59	250	5.671	.000*
	No	172	3.46	.65			

*p<0.05

When the self-efficacy of classroom teachers towards gifted students was analysed according to the teachers' education status, it was found that there was a statistical difference (p<0.05). Accordingly, when it was examined between which two situations there was a difference, it was found that the scores of the teachers who received training in all dimensions except the Responsibility dimension (p>0.05) were statistically significantly higher.

Conclusion and Discussion

Since teachers' sense of efficacy is related to students' success, it is important to determine how teachers with different levels of efficacy behave in the classroom. Such data are important in terms of revealing the differences between teachers and the role of these differences in student achievement (Dembo & Gibson, 1985). Teachers with high level of self-efficacy take individual differences of students into consideration while planning the teaching process. Individuals who exhibit a high level of performance compared to their peers and have a strong sense of creativity are defined as gifted (Renzulli & Delcourt, 1986). As can be understood from the definition, gifted students differ from their peers. Self-efficacy of classroom teachers in the education and identification of gifted students who show different characteristics from their peers is important. In this study, the self-efficacy of classroom teachers working at the first level of basic education towards the education of gifted students was analysed in terms of different variables.

In this study, when the self-efficacy of classroom teachers regarding the education of gifted students was examined in terms of gender, it was concluded that there was a differentiation in favour of men in the personality trait sub-dimension. When the literature was examined, it was found that different results were reached and that there was no significant difference between the attitudes and self-efficacy of classroom teachers towards gifted students and the gender variable (Güneş, 2015; Dinçer, 2019), as well as research findings (Girgin & Şahin, 2019; Vatansever Bayraktar, Kadıoğlu Ateş & Afat 2019; Yıldız, 2020) showing that male teachers' self-efficacy for the education of gifted students is higher than female teachers. In another study, it was concluded that women's self-efficacy levels in Mentoring and Responsibility dimensions were statistically significantly higher than men (Abanoz, 2021). According to the literature, it is understood that there are studies that overlap and do not overlap with the results of these research findings. This situation shows that there is a need for more research on the subject.

In the study, it was observed that the self-efficacy of classroom teachers regarding the education of gifted students did not differ in terms of professional seniority. Yıldız (2020) found no difference in classroom teachers' self-efficacy beliefs towards gifted education in terms of professional seniority. Abanoz (2021) concluded that teachers between the ages of 20-29 were more conscious about the education of gifted students than teachers aged 50 and over. In Sürmeli's (2015) study, it was found that teachers with professional experience over the age of 40 had a lower level of awareness about giftedness than their other colleagues. There are studies suggesting that awareness of gifted students increases with increasing seniority in the profession (İnan, Bayındır, & Demir, 2009; Şayir 2015). It can be thought that the

different results in the studies may be caused by situations such as the trainings given in universities on these issues recently due to the increase in awareness of gifted students, the level of awareness of young teachers by doing more research on gifted students, and the increasing professional experience due to the increase in years of service.

When the educational status of classroom teachers was analysed in terms of their self-efficacy, it was found that there was a statistical difference in the total, academic and planning sub-dimensions of the scale. In Abanoz's (2021) study, a significant result was found between teachers' self-efficacy and their educational status. At the end of the study, it was concluded that teachers with postgraduate degrees nominated students to BİLSEM at a higher rate than teachers with undergraduate degrees, and the rate of winning BİLSEM among the candidates they nominated was higher than the undergraduate level. Similarly, Karahan and Balat (2011) found that there was a differentiation in teachers' professional self-efficacy according to their educational levels. The results of the study may be due to the fact that the postgraduate education of the teachers may create awareness about gifted students and they may be able to distinguish gifted students from others more easily due to their characteristics.

A significant difference was found in the counselling and planning sub-dimensions of the scale between the self-efficacy levels of classroom teachers towards gifted students and the status of nominating students to SAC. This difference was found to be in favour of the teachers' winning at least one of the students nominated to SAC. While collecting data, the items of the nomination variable were "I nominated at least one of the students won, I nominated no winner, and I was not nominated". In Abanoz's (2021) study, a statistically positive significant relationship was found between the total scale and the dimensions of Encouraging Creativity, Appropriate Personality Traits, Academic Competence and Mentoring. Akar and Uluman (2013) found that the rate of classroom teachers who correctly nominated gifted individuals was 18%, while this rate was 31.3% in Abanoz's (2021) study. This can be interpreted as an increase in the level of classroom teachers' correct nomination over time. Based on this, it can be concluded that classroom teachers' self-efficacy on giftedness can be associated with the process of nominating students to SAC. Thus, it is estimated that classroom teachers who nominate students have a high level of awareness about giftedness.

When the self-efficacy of teachers with gifted students in their classrooms was examined compared to teachers without gifted students in their classrooms, a statistically highly significant relationship was found in favour of teachers with gifted students in their classrooms in all dimensions except the Responsibility dimension. This result supports the findings of similar studies (Şayir, 2015; Abanoz, 2021). Starko and Schack (1989) found that there were differences in the self-efficacy of teachers with gifted students in their classrooms and interpreted this result as both the experience of working with gifted children and the increased interest in the needs of these students.

Classroom teachers' giving courses to students diagnosed with giftedness in the support education room was found to be statistically significant in all dimensions except for the sub-dimensions of responsibility and encouraging creativity. Afat (2017), based on the fact that 2% of the population is gifted, stated that the proportion of this group receiving education in the support room in the province where the research was conducted was below 1%. In addition, it was stated that only 44% of the students with enrichment measures were given education in the support room by the Guidance Research Centre. In this study, it was observed that 12.3% of the classroom teachers who gave courses in the support education room to students diagnosed with giftedness. This low rate may have been caused by various reasons such as the fact that classroom teachers and student parents did not know that gifted students could be given courses in the support education room, the lack of adequate infrastructure in schools, the lack of documents such as enriched education plans and printed resources, and the inadequate wages of the teachers who would give courses. As a result, it is thought that it may be useful to include dissemination studies on support education rooms and activities that will increase the competencies of teachers in this regard.

When the self-efficacy of classroom teachers towards gifted students was analysed according to the status of receiving in-service training and courses, it was concluded that teachers who received training in all dimensions of the scale except the responsibility dimension were statistically highly significant. Copenhaver and McIntyre (1992) stated in their study that teachers' participation in in-service trainings about gifted students can give them positive attitudes.

Tortop and Dinçer (2016) stated in their study that in-service trainings are important for understanding gifted students. Similarly, Kaya and Ataman (2017) emphasised that in-service trainings should be provided to understand gifted students. Based on the results obtained, it is estimated that classroom teachers' in-service training and course taking may create positive awareness about gifted students' self-efficacy.

The results showed that classroom teachers' postgraduate education, having gifted students in their classrooms, giving courses to students diagnosed with giftedness in the support education room, and receiving in-service training and courses for gifted students were positively related to their self-efficacy level. Currently, the fact that the Ministry of National Education requires 20% of primary school 1st, 2nd and 3rd grade students to be nominated in the process of nomination to SAC, the educational status and experiences of classroom teachers gain importance in identifying the right candidates in the nomination process. Providing support to classroom teachers to increase their knowledge and experience about gifted students will ensure that the process of selecting candidates for SAC is operated correctly and that gifted students receive education in line with their talents.

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Research Article

Evaluation of training workshop curriculums for gifted and talented students

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Abstract

One of the critical points that can determine the future of a country is the education of the gifted and specially talented children there. Many civilizations from past to present have attached importance to this education. The aim of this study is to evaluate the educational workshop curriculums applied for gifted children according to the Context-Input-Process-Product (CIPP) model. For this purpose, a research was carried out with six teachers, a psychologist, an education coordinator and two administrators working as practitioners in the workshop training curriculums for the gifted students implemented in the 1st semester of the 2019-2020 academic year. In the study, semi-structured interviews according to CIPP steps were collected by interviewing the participants one-to-one for 8 weeks within a 16-week training curriculum. According to the findings obtained; The quality of education given to gifted children should be increased. In addition, it was seen that it was necessary to systematically examine the opinions expressed by the curriculum practitioners and to make the necessary changes to the curriculum in a planned manner. In the light of these findings, about workshop training curriculums; increasing the adequacy of the physical environment, disseminating studies on creative thinking skills, opening different trainings for all areas of development and ensuring that children can participate in the areas they want have been achieved. The strengths and weaknesses of the implemented curriculum will be revealed, allowing its practitioners to create a more efficient training system.

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Introduction

Human history contains many breaking points where great changes have taken place. These breaking points often involve various inventions. The main reason for the emergence of all these inventions is that the individual asks the question "why?" When this question is asked about a phenomenon, a difficulty, a tradition, and so on, one has to create differences. Because of this necessity, the importance of the field of education of gifted and specially talented people in the educational philosophy of our age has been revealed. In order to meet the advanced learning needs of students with gifted, it is important to establish an adequate infrastructure in general education activities and to differentiate, enrich, accelerate and develop curriculums for gifted children (Lo et al., 2019). Although special ability is seen as an advantage at first glance, various problem behaviors can be observed in these children due to the fact that individual differences are ignored or the attitudes towards it are wrong by the environment (Heiss, 1995). A good understanding of the individual

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characteristics and abilities of the gifted children is one of the prerequisites for the development of a good curriculum. In this respect, both the emotional and cognitive development of gifted children should be well known, this information should be shared with the environment and the knowledge and skills of environmental factors should be developed.

Gifted children and their education

Simply defined, a gifted person has important differences between an individual and their peers in terms of general and personal characteristics. These differences are measured by experts and implemented with the help of in a different way where curriculums are inadequate (MONET, 1991). Renzulli (1999) divided gifted abilities into two types. These are learning-based and creative-productive. Learning-based aptitude is a special group of abilities that can be easily measured in standardized aptitude tests. Individuals who demonstrate special ability on these tests are those who excel in analytical skills in traditional curriculums. Creative productive ability is the ability to easily achieve a goal in one or more of the original ideas, products, artistic expressions, and cognitive domains.

Education models for gifted

The education of gifted children has been important in the world since the earliest times. The most important discoveries that contributed to the development of human history were made by gifted individuals. Marcus Fabius Quintilian, one of the important educators and orators of the Roman period, also emphasized the importance of individuals with gifted. In ancient China, gifted children were said to be the most important element for national well-being. Confucius' ideas about individuals with gifted played an important role in the development of Chinese Civilization (Vainer, Gali, and Shakhnina, 2016). Studies on the concept of gifted and educational practices for gifted students have systematically entered academic fields at the beginning of the 20th century. With the development of industrialization in the 19th century, qualified personnel were needed and with it the educational activities grew (Lo et al., 2019). With increased educational activities, educators who better observe student achievement have begun to recognize the different learning needs of successful students (Davis et al., 2015). To meet these learning needs, studies such as schools and accelerated curriculums for students with gifted began to increase in the late 19th century (Freeman, 2002). However, the emergence of psychometric measurements is one of the factors that have led to the development of the education of the gifted students. With the development of scales such as the Stanford-Binet Intelligence Scale (Terman, 1916), the success and learning potential of gifted children in these tests have shaped educational disciplines (Jolly, 2018).

When look at recent history, the first study on the education of gifted people in the United States was started by Hollingworth in New York in 1922. In 1926, Hollingworth published Gifted Children: Their Nature and Nutrition. This book is considered to be the first published on gifted children(Klein, 2002). Today, there is no legal regulation in the United States to identify gifted children and to work to meet their special needs. Therefore, each state organizes and implements its own work for individuals with gifted. The National Association of the Gifted provides rules, policies, and procedures related to educational activities and aims to conduct these activities systematically (Reid, 2015). However, the study by Gubbins, Callahan and Renzulli (2014) proved that less than half of the regions meet the established standards. The training of people with gifted is carried out in their regular classrooms, and their teachers are usually not given special training in this area. Pomortseva (2014), in his study on the education of gifted children in standard classrooms in the United States, stated that the activities set for other children and the achievements of these children are very different from those of gifted children.

When look at the Netherlands in Europe, the most preferred education method for people with gifted is curriculum enrichment. Skipping classes, taking classes with upper-level classes are common practices (Reid and Boettger, 2015). In the Netherlands, special ability is accepted as a common cluster formed by the combination of genetic factors such as special and general mental abilities, creative abilities, motivational abilities and environmental factors such as family, school, peer groups, community influence in determining gifted children (Gyarmathy, 2013). In the UK, the history of education of gifted children dates back to 1944. Today, the British education system works to ensure that all children receive a good education. Therefore, gifted students are required to participate in the same educational activities as their peers (Reid and Boettger, 2015). In the Finland, it is seen that the most powerful aspect of the education system is that it allows schools to institutionalize educational activities and allows students to participate in educational activities

specific to their abilities and to realize themselves individually (Reid, 2015). In this structure, teachers at all grade levels participate in academic trainings on curriculum for differences from kindergarten to upper grades. Teachers receive their training on the gifted students during differential training (Tirri and Kuusisto, 2013). The processes for the education of people with special disabilities in Singapore are carried out by the special talented unit of the Ministry of Education of Singapore. Educational activities enrich the curriculum in areas in which students are particularly gifted, optimally preparing students for university exams in a way that allows them to take courses with higher classes and in the classroom (Heuser, Wang and Shahid, 2017).

On the identification of gifted children, defines the educational activities of the Russian Federation. These educational traditions of the past specialized in gifted children, organized trainings and identified gifted children. Today, multiple field tests or performance-based tests are carried out specifically for individuals who are considered gifted. Once diagnosed, individuals with gifted are placed in schools that are on par with other schools but carry out their activities with gifted children (Grigorenko, 2017).

Gifted education in Türkiye

In the training of gifted individuals in Turkish history, attention should be paid to the period when the Ottoman Empire reigned. The Ottoman State, which became aware of the special talent in this period, took the children who came to the forefront in certain criteria in the regions within its borders and educated them in Enderun schools (Şahin, 2013). In Enderun schools, students are selected according to their cognitive and artistic abilities, there is a balanced curriculum to support the development of the child in all aspects, the students' own preferences are given importance in subject selections, and there is a merit system that directs education (Akarsu, 2004). This effort of the Ottomans stemmed from the concern that every gifted child would be seen as a precious stone and processed in expert hands. Because in the enderun schools process, gifted children are mostly senior managers, those who make and implement decisions in political and economic fields, those who put forward and realize the ideas of new inventions, and research and development departments (Orbay et al., 2010).

In 1995, Science and Art Centers (SAC) were established by the Ministry of National Education of Türkiye (MONET). The educational activities carried out in SACs are planned and carried out at all levels of education. In the preschool period, it is aimed to conduct developmental tests compared to intelligence tests for children and to educate families and to carry out joint studies. In the future planned to implement such studies more effectively by integrating the class skipping procedures applied in gifted children, enriching the curriculum, conducting separate training and acceleration studies on grade progression (MONET, 2019).

Curriculum evaluation and Stufflebeam's CIPP model

The evaluation of educational activities is very important in terms of increasing the effectiveness of school work and the quality of education provided. While these improvement efforts are student- and teacher-focused, they are valuable in assessing and improving the school's administrative, pedagogical, and administrative readiness (De Grauwee and Naidoo, 2004). One of the most popular curriculum evaluation models for the evaluation of curriculums is the Context-Input-Process-Product (CIPP) model developed by Stufflebeam in 1971 (Darma, 2019). Each letter in the CIPP abbreviation represents the first letters of 4 separate sections of the evaluation process. The first part means context, the second part means input, the third part means process, and the fourth part means conclusion.

Curriculum evaluation in education of gifted students

Differentiated educational designs prepared for students with gifted have been an area of problems in the decision and implementation process for many years in terms of education policies. In her study, Christo (2019) emphasizes that educational designs of gifted people are not systematically evaluated according to national curriculum evaluation criteria, and that curriculum designs should be evaluated in , method and materials. The education of the gifted students is interrupted due to various reasons such as the curriculum prepared with the determined education policies do not meet the needs of the students and the deficiencies in the application. For this reason, curriculums prepared for gifted students should be carefully examined and evaluated in terms of all sub-fields. In their study, Hunsaker and Callahan

(1993) examined various assessment models used and used in the education of gifted people, evaluated discussions, evaluation partners, reports, systems, and inter-field relationships. In the examinations, in the education of people with gifted, very little curriculum evaluation or unsatisfactory results of the evaluation were seen as the main problem. The most difficult point for gifted students to participate in general curriculum is the child's need to produce. Meeting the productivity needs of children by making some products desirable or close to desirable within the scope of their own competence strengthens their relationship with self-efficacy (Shack, 1989).

Literature Review

In their study on the failures of the gifted minority children who are below the success expected of them, Ford and Thomas (1997) have addressed the causes of the problem in 3 stages. They stated that the differentiation of students in society was due to both cognitive and ethnic origin differences. They also say that these differences affect their socio-psychological structure. The fact that the socio-economic status of the family is low compared to the society reduces the success of the children by limiting the expectations of the family about the child.

Winebrenner and Brulles (2008), in their study on the needs of gifted children, mention that the gifted participating in the general curriculum fall behind according to their own developmental standards. For this reason, with the cluster group model that can be applied in schools, it has been determined that teachers can reach their self-success in educational activities by ensuring that teachers are in the same educational environment with similar students where they can do activities according to the needs and learning speeds. Tiantong and Tongchin (2013) conducted a model development based on the process of developing and evaluating the internet-based collaborative learning approach with the theory of multiple intelligences in accordance with the structure of the CIPP model. This model has proven to be efficient in terms of having positive learning lives for students, strengthening their approach to learning and providing feedback to both successful and unsuccessful students in a healthy way. Reid and Boettger (2015), in their studies in which various countries in Europe carried out activities related to the education of the gifted students; most of them stated that the policies for the education of gifted students were aimed at ambitious and high-achieving children, and that children who did not possess these characteristics were left idle. In her study, Kim (2016) conducted a meta-analysis of 26 different enrichment curriculums for gifted students between 1985 and 2014. Among the curriculums, the summer programs have had the greatest impact both academically and in terms of social-emotional development. Weyns, Preckel and Verschueren (2020) investigated the perspectives of prospective teachers studying at the university about the personality traits of gifted students and teacher-student relations. As a result of this research, it has been revealed that the fact that the student is at the level of gifted or normal intelligence will not create a problem in terms of teacher-student relations. Thus, it was determined that teachers who had gifted students in their classes made them open to learning in terms of awareness of the personalities and communication of gifted.,

When we look at the studies in Turkey; Melekoğlu, Çakıroğlu and Malmgren (2009), in their study on the education of gifted students in Turkey, have contributed to the improvement of the quality of educational activities by revealing the structure of the studies on gifted students in the history of Turkish education and evaluating these studies together with new developments. Çelikdelen (2010), in his study, revealed that students memorized the concepts they learned in science and technology courses during the general education process and could not develop the skills to transfer the learned information and use it in real life. In his study on the diagnosis of gifted children, Şahin (2013) concluded that the diagnosis of the gifted student is adversely affected by the systems currently used. Alevli (2019), in her case study on the Turkish curriculum applied to gifted students in BILSEMs, tried to collect information about the implementation of the educational activity, to reveal the opinions of the stakeholders and to put forward suggestions for the development of the educational activity. Regarding the relationship of parents with educational activities, Akbüber et al., (2019) stated that parents do not want their children to specialize in one area according to their abilities, but to develop in an area according to their economic ambitions and expectations. Bayraktar Keleş (2020), in her study on the problem behaviors of gifted children revealed that teachers generally applied to guidance services in the face of problem behaviors and interviewed families. Although teachers preferred cooperation as a problem behavior solving technique, it was determined that they also used punishment-based practices in the findings obtained from the observations.

Problem of Research

The workshop curriculums of the Gifted and Genius Children Education Foundation of Turkey (TÜZDEV) in Turkey support general education activities for students with gifted. In the study, it is aimed to evaluate the workshop curriculums applied for gifted children in TÜZDEV according to Stufflebeam's Context-Input-Process-Product process in terms of teachers. In the education of gifted children, different educational models are used. Stufflebeam's CIPP model, which was selected at this point, is a powerful curriculum evaluation method in terms of analysis of qualitative data as a result of interviews with teachers. The evaluation model has a formative structure in the research since it is made with the aim of improving the curriculum being implemented (Kara and Akdağ, 2017). As a result of this study, the advantages and disadvantages of the workshops to be held with gifted students will be determined by looking at all these processes and suggestions are presented about what can be done to improve the curriculum according to the determined criteria. In this context, the following questions were sought to be answered in the research:
The training curriculum for students with gifted;

- What are the curriculum practitioners' assessments of the context dimension?
- What are the curriculum practitioners' assessments of input size?
- What are the curriculum practitioners' assessments of the process dimension?
- What are the curriculum practitioners' assessments of product size?

Method

Research Design

Qualitative research method was used in the study. Data were collected through semi-structured interviews with workshop teachers, curriculum experts and administrators in accordance with the steps of the CIPP model, which were planned every 2 weeks over a 20-week period. The most important structure of qualitative research is that people transfer their own experiences about their lives to the researcher using their own expressions. (Cropley, 2019). Since qualitative research does not tend to prepare an environment suitable for the purpose of research, data are conceptualized and structured after the research is conducted (Punch, 2005). The qualitative research method has a complex, controversial and variable structure that includes many methods and research applications. This type of research does not focus on a single direction and gathers all the concepts within the research under one roof (Punch, 2005). The research sample was prepared by the Gifted and Genius Children Education Foundation for the year 2019-2020 1. It consisted of teachers, administrators and curriculum experts who implemented workshop training for gifted children during the period.

Participants

In the study group, there are 11 gifted and genius children aged 9-10 who have received 110-150 intelligence test scores, 6 workshop teachers who conduct workshops, a psychologist responsible for the organization and functioning of these training curriculum, an education coordinator and 2 administrators.

Data Collection Tools

All stages of the targeted evaluation model were evaluated in detail with a semi-structured interview scale prepared for use in teacher interviews. The data collection tool was first presented to course teachers for the evaluation of the English language teaching curriculum. In line with the workshop curriculums for those with gifted students on the scale, word changes were made that would not disrupt the validity and reliability of the study. The qualitative data tool used in the study is the semi-structured interview scale developed by Beste Dinçer in 2013 in order to determine the opinions of teachers who are primary school 7th grade English curriculum practitioners about the curriculum. The questions used in the scale were prepared in a logical order according to the CIPP (Context-Input-Process-Product) evaluation method and asked directly to the teachers. Each question is prepared to measure one of the markers of the evaluation curriculum (Dinçer, 2013).

Data Analysis

The analysis of the data obtained as a result of one-on-one interviews with the teachers was analyzed using the content analysis method. Appropriate themes were determined for the questions and themes, categories and code lists were prepared by examining the opinions of the teachers at each question level. Teachers' opinions that are considered important at this point are shown in the analysis without comment. Upon the change of the STEM workshop teacher, the context and input sections were discussed at the end of the first day in the same interview with the new teacher. The evaluations of the process and product sections were continued with the new teacher by adhering to the process.

Data Collection Checklists

In the process of research; A checklist has been prepared in order to proceed consistently, to analyze the data collected as a result of the research and to assist in the process of interpreting these analyzes. The checklist is prepared in 2 different ways. The data checklist is given in Table 1 and the checklist prepared as the implementation schedule is given in Table 2.

Table 1. Data checklist

Participant Number Workshop/Stage	Volu ntary	Context	Input	Process	Process	Process	Process	Product
1. Stone Painting	+	+	+	+	+	Workshop last		+
2. Drama	+	+	+	+	+	+	+	+
3. STEM	+	+	+	+	Interview	+	+	+
4. Robotic Coding	+	+	+	+	+	+	+	+
5. Fun Math	+	+	+	+	+	No Teacher	+	+
6. Foundation Member	+	+	+	+	Single conversation			+
7. Foundation Psychologist	+	+	+	+	Single conversation			+
8. Administrator 1	+	+	+	+	Single conversation			+
9. Administrator 2	+	+	+	+	Single conversation			+

Table 2. Collection of qualitative data implementation schedule

Application Schedule	Stone Painting	Drama	Fun Math	Robotic Coding	STEM
14 September 2019	+	+	+	+	+
28 September 2019	Trip organized				
12 October 2019	+	+	+	+	+
26 October 2019	+	+	+	+	+
2 November 2019	+	+	+	+	+
16 November 2019	Break holiday				
30 November 2019	Workshop last	+	No teachers	+	+
7 December 2019		+	+	+	+
21 December 2019	Forest Park workshops				
4 January 2020	+	+	+	+	+

Results

Rating Sizes Theme List

As a result of the content analysis of the responses to the teacher interview forms, 14 themes were formed. These themes are given in Table 3. The changes made as a result of associating the answers given by the teachers to some questions with other questions are mentioned in detail in the subheadings.

Table 3. emerging themes by assessment dimensions

Themes	
Context Evaluation	Aim of the curriculum Strengths of the curriculum Weaknesses of the curriculum Student needs
Input Evaluation	Student login features Teacher readiness level Material property and adequacy
Process Evaluation	How the implementation process works Methods and techniques used Difficulties experienced
Product Evaluation	Curriculum meeting expectations Assessment of students Adequacy of measuring tools Ideal workshop curriculum

Insights into the Context Dimension

Views on the aim of the curriculum are given in Table 4.

Table 4. Aim of the curriculum

Theme	**Category**	**Code**
Aim of the Curriculum	Unlocking talent	Development of expressive skills Creating products from different materials Developing scientific thinking skills
	Development of adaptation skills	Arrangement of characteristic features Overcoming the fear of failure Ensuring communication with peers at the Same level of intelligence
	Learning life skills	Increasing their self-confidence Strengthening communication skills Understanding life with science Understand and apply technological developments
	Increasing the enjoyment of educational activity	Game-based education A like of science. Creating an environment where they can express themselves

As the participants stated in the interviews, the aim of the curriculum is to reveal the talents. The opinions of some of the participants (2, 7, 9) who expressed their views on the emergence of talents; *"Improving their self-expression skills" (*Drama*), "To develop the abilities of children and to develop and reinforce these issues if there are deficiencies" (Foundation* Psychologist) and "*To gain a different perspective on the education of gifted children, to improve their skills and to realize their talents"* (General Manager of the Foundation).

In another opinion, the participants stated that the aim of the curriculum was to improve their adaptation skills. The opinions of some of the participants (1, 2, 3,) who expressed their views as the development of adaptation skills were: *"Among the objectives of the curriculum are art and rehabilitation*" (Stone Painting), "*To prevent children from being dominant or recessive in their environment and to ensure that they adapt to their environment in the best way"* (Drama), *"In order to reduce the feeling of failure in case the results are unexpected, it is also tried to gain the skills to cope with negative situations" (*STEM).

Finally, it is another dimension emphasized by the participants about the purpose of the curriculum that the enjoyment of educational activities should be increased. Here are examples of direct statements of the participants; *"To create environments where children can feel comfortable and to teach children that there can be learning outside of school*

by removing them from the learning environment such as school" (Fun Mathematics), *"To maximize children's happiness and to ensure that they can enjoy their education"* (Member of the Board of Directors).

Strengths and Weaknesses of the Curriculum

Views on strengths and weaknesses of the curriculum are given in Table 5.

Table 5. Strengths and weaknesses of the curriculum

Theme	Category	Code
Curriculum Strengths	Carrying out practical studies	Creating new products from various materials Translating the use of technology into producing technology Associating life and mathematics
	Be socially and cognitively active in workshop activities	Collaborating Children feel understood in workshops
Weaknesses of the Curriculum	Insufficiency of the physical environment	Presentation of workshop materials by the teacher Non-compliance of the workshop environment with planned activities Insufficient time given for the workshop
	Their inability to choose the workshop they want	Not being able to attend workshops appropriate to abilities Children are not exposed to challenging activities
	Areas of incompatibility	Mismatch between school curriculum and workshop curriculum Problems in participation

As the participants (2,3) stated in the interviews, one of the strengths of the curriculum is the practical work. In addition, the participants; *"Using materials from nature, creating products and contributing to the product with their hand skills*", "Since they have lives on the phone and computer all the time, they get excited when I tell the children that they can do it themselves*".*

As the participants(1,5) stated in the interviews, one of the weaknesses of the curriculum is the inadequacy of the physical environment. *"Having a school class is physically challenging for me, I need a drama field", "* The *time given for the curriculum is insufficient. Because 1 lesson hour is not enough to produce products in this workshop*", have also emerged as the weaknesses of the curriculum. Another weakness is the inability of children to choose the workshop they want and various incompatibilities. The adjustment problem was described by the participants as *"There are children who have adaptation problems. An adaptation week can be arranged".*

Student Needs

The code and categories related to the context evaluation section are evaluated in detail in Table 6.

Table 6. Student needs

Theme	Category	Code
Student Needs	State of interest in the workshop	The situation of students who are not interested in the workshop
	Categorization of needs	Having learning environments by doing, experiencing, Prejudice against the workshop curriculum Being with children with the same level of cognition Aiming for self-expression skills Determining the needs of children according to their skills Workshop curriculum with a dominant focus on production
	The relationship of workshop activities with daily life	The event is not limited to workshop hours only; Strengthening of social interactions Use of learned skills

As the participants stated in the interviews, the first issue related to student needs is the state of interest in the workshop. Since not every student is interested in every workshop, a standard curriculum means that not all students are participants in all workshops. For this, it is stated that student needs should be divided into categories. Another student need is that the workshop activities should be determined from the activities for use in daily life. In summary, it is stated that increasing the interest of students in workshops plays a key role in workshop training.

Opinions on Input Size

Views on student features are given in Table 7 and views on teacher readiness level is given in Table 8.

Table 7. Student features

Theme	Category	Code
Student Login Features	General readiness	Be competent to perform the targeted skills Direction of their individual goals
	Causes of student-related problems in workshops	Thinking that he has no talent about the workshop he attends Problems arising from personality traits Inability to learn Different age groups participating in the same workshop

As the participants stated in the interviews, the first issue related to student entry characteristics is general readiness. In this regard, the participants (2,3) are; "There is no lack of class participation, group work. They perform the desired skills. Girls are generally good at attending classes", "They are distracted, they like to play, their minds are channeled into the game".

Table 8. Teacher readiness level

Theme	Category	Code
Teacher Readiness Level	Previous trainings received about the workshop	Ensuring personal development Trainings received in the field Previous studies on the gifted students
	Situations related to workshop curriculum applications	Efficient participation of children in activities Lack of expected prerequisite skills in children

As stated by the participants in the interviews, teacher readiness level emerged as two categories. These are: previous trainings received about the workshop and situations related to the workshop curriculum applications. In addition, it was also stated in the interviews that the fact that the students kept the materials of the workshop curriculum they entered in the previous hour during the change of the workshops caused a problem of focusing on the workshop they entered.

Material Property and Adequacy

Views on material property and adequacy are given in Table 9.

Table 9. Material property and adequacy

Theme	Category	Code
Material property and adequacy	Characteristic of the material	The materials to be used in the workshop are provided by the foundation
		In workshops such as drama and fun mathematics workshops, activities are driven by activity rather than material
	Adequacy of the material	Sufficient for workshop application as materials are provided on request
		Since very complex materials are not used, the materials provided are sufficient Materials can be used for many purposes in workshops

The first issue related to material property and adequacy in the research is the property of the material. The other is the sufficiency of the material. It is stated that the workshop teachers supply the materials needed during the organization and maintenance of the workshops in the institution where the work is carried out. In this way, the progress of the workshop activities was expressed positively. It is observed that the materials used in the workshops are not complex materials and it is possible for students to provide these materials with their own means. The drama and entertaining mathematics workshop teachers stated that the work done in the workshops was carried out not only on physical materials but also on the student.

Opinions on the Process Dimension

Views on how the implementation process works are given in Table 10.

Table 10. How the implementation process works

Theme	Category	Code
How the implementation process works	Factors affecting the feasibility of workshop activities	Children do not want to participate in workshop activities
		Distractions in the workshop environment
		Difficulties of children in progressing process-oriented in the activities
		Negative student attitudes towards the workshop
		Difficulties encountered with the low number of students in the drama workshop
	Positive developments in the implementation of workshop activities	Increased level of attention and interest in the workshop
		Measures to be taken in the emergence of behavior problems Increasing the pleasure of the workshops

According to the opinions of the participants in the research, the functioning of the implementation process are the factors affecting the applicability of the workshop activities and the themes of positive developments in the workshop activities come to the forefront. It is stated that the distractions in the workshop environment and the fact that the number of students does not bring a standard on the basis of the workshop affect the operation of the workshop.

Methods and Techniques Used

Views on methods and techniques used are given in Table 11.

Table 11. Methods and techniques used

Theme	Category	Code
Methods and Techniques Used	Progress of methods and techniques in practice	Using peer support Selecting methods and techniques appropriate to the workshop operation
	Problems encountered with methods and techniques	Required prerequisite skills have not been previously learned Problems encountered due to limited time

As stated by the participants in the interviews, the progress of the methods and techniques used in practice and the problems encountered with the methods and techniques are the prominent information of the theme of the methods and techniques used. The selection of the methods and techniques used in the workshops was made considering the processing of the workshop and ensured that the practices of the workshop continued in a healthy way. At this point, supporting the students with different individual abilities to support each other among themselves was found to be successful by the stone painting workshop teacher. The participants also stated that the prerequisite skills required for the application of the methods and techniques have not been acquired beforehand, the duration of the workshop is limited to minutes and not until the product is created, and the problems experienced by the students in receiving and following the instructions in some workshops cause problems in the operation of the methods and techniques applied in the workshop.

Difficulties

Views on difficulties experienced are given in Table 12.

Table 12. Difficulties experienced

Theme	Category	Code
Difficulties	Supporting workshop	Having trained personnel to support workshop activities Precautions brought about by the fact that the workshop area does not belong to the foundation Content-related issues
	Student-related problems	Children's difficulties with the instructions given Having distractions Problems they have among themselves
	Changes observed in the workshop process	The necessity of joint work with parents Being prepared for the unexpected The advantages of knowing children's personalities Different methods attract the attention of children

As it is understood from the table, the first issue related to the difficulties experienced is to support the workshop process. The other is student-related problems. Apart from these, participant number 5 (Fun Math) 1. In the interview, he mentioned that gifted students are extremely important.

In summary, the difficulties experienced in the organization of workshop curriculums are that it is necessary to have trained personnel about the workshop contents. In addition, in order to support the workshop process, it is also desired that the workshop areas are specific to the workshop applied. Since the content applied in the workshop is for the time that needs to be planned, the workshop teacher mentions that he has problems with his planning. Students' instructional and distraction problems are another important problem encountered in the workshop process.

Curriculum Meets Expectations

Views on curriculum meeting expectations are given in Table 13.

Table 13. Curriculum meeting expectations

Theme	Category	Code
Curriculum Meets Expectations	Meeting the expectations and needs of the teacher	Strengthening curiosity and interest Increased experience of gifted students
	Meeting student expectations and needs	Children want to actively participate in the workshops Enjoy workshop activities

As can be seen in Table 13, the first category related to the curriculum meeting expectations is the teacher's meeting expectations and needs. The second is to meet the expectations and needs of the student. Considering that the 40-minute workshop time was not enough, the participant number 4 stated that this time was insufficient for the products to be as desired. Regarding the expectations of the students, the participants stated that their sense of curiosity developed with the children's willingness to participate in the workshops. It is seen that the workshop curriculums mentioned earlier for the children to evaluate their free time at the weekend are supported by the indication of the children's enjoyment.

Assessment of Students

Views on assessment of students are given in Table 14.

Table 14. Assessment of students

Theme	Category	Code
Assessment of Students	Structure of the assessment	Students' interest in the products made in the workshop activities Creating a self-evaluation structure of the workshop The necessity of making a work done in the virtual environment tangible Avoiding test anxiety
	Effectiveness of measurement type and tools	Process-based assessment Continuity of the workshop activity outside the workshop Creation of a portfolio book

As the participants stated in the interviews, the first issue related to the curriculum's meeting the expectations is the structure of the evaluation, and the second issue is the effectiveness of the measurement type and tools. Teachers focused on two views on evaluations in the conduct of the workshop curriculums. The structure of the assessments and the type of measurement and the effectiveness of the tools are these opinions. With the increase in the students' interest in the activities carried out in the workshops, it was stated that these evaluation activities were carried out in accordance with process-based evaluations.

Ideal Workshop Curriculum

Views on assessment of students are given in Table 15.

Table 15. Ideal workshop training curriculum

Theme	Category	Code
Ideal Workshop Training Curriculum	Recommendations on the preparation and implementation process of the curriculum	Extending the workshop duration from 40 minutes to 60 minutes Opening workshops for different age groups
	Recommendations on physical facilities	Orderly storage of workshop materials Creation of physical areas of workshops
	Recommendations on methods and techniques	New methods and techniques to add Integrating art and sports activities into workshops Making plans to control problem behaviors

In the research, recommendations about the ideal workshop curriculum emerged in three categories. The first category is the process of preparing the curriculum, the second category is the recommendations about physical environments, and the third category is the recommendations about methods and techniques. It is reported in the recommendations that the effectiveness should be improved by using different methods and techniques, that art and

sports activities should be included in the curriculum, and that plans should be made in the control of problem behaviors.

Conclusion and Discussion

In this study, it is aimed to evaluate the training workshop curriculums applied for gifted students according to the Contex-input-process-product (CIPP) model in the context of Stufflebeam. In the workshop training activities, the students and the teachers who conduct their lessons have stated various goals for their own workshops. The gifted students curriculum examined in the research was found to be sufficient in terms of the purpose of the curriculum. Because teachers have acted according to the Stufflebeam approach when planning their workshops. The ideas of administrators and curriculum experts that the social skills of gifted students should be supported due to their individual differences coincide with the ideas of teachers. It is important to prepare curriculum that include approaches that will strengthen children's social communication and interactions.

In the research process, the teachers' opinions about the workshop curriculum show that the aims to improve the social skills of the children such as trying to strengthen the weak features of the children, bringing the healing effect of art to the forefront, and trying to gain the skills to cope with negative situations are also included in the curriculum. Çubukçu and Gültekin (2006) state that the social skills that need to be gained are the skills of working with the group, the skills of making plans and solving problems, the ability to respect the rights of others and the ability to express their feelings. The responses of the teachers in the research support this view. In determining the objectives of the curriculums to be prepared for gifted students, it is necessary to set goals for the individual characteristics of children, critical thinking, creativity, and the development of advanced thinking techniques. The ideas of the administrators and the ideas of the teachers that the social skills of the gifted students should be supported due to their individual differences coincide. It is important to prepare curriculum that include approaches that will strengthen children's social communication and interactions.(Callahan, 1986). Participants stated that a learning environment should be created that children can enjoy and game-based educational activities should be organized. Gökalp (2017) supports this view and said that game-based activities can make learning enjoyable so that non-participating children can participate and thus knowledge can be reinforced. Pivec, Dziabenko, and Schinnerl (2003) say that game-based activities increase learners' courage to make decisions at critical points, interact with other friends, generate ideas about the game, take action, and generate ideas to improve the game, and improve other social skills.

The fact that the curriculum is practice-oriented is a feature that strengthens the activity according to the opinions of the teachers. Slavin (1980) states that the use of practice-oriented studies in lessons attracts the attention of students more than traditional models. Johnson, Johnson, and Taylor (1993) state that problems experienced by gifted students in their social acceptance have an impact on their level of achievement. The fact that gifted students often have low levels of achievement is a result of their self-esteem and peer rejection. These views coincide with the view that managers' social development is supported by coming together with peers with similar interests. Organization and intensity of the teaching environment, class size, fitness for purpose of the environment required for study; It affects the student's success, motivation, social communication and sense of responsibility (Şensoy and Sağsöz, 2015). According to the opinions of the teachers, the fact that the physical features in the environment to be applied are not suitable for the workshop curriculum is one of the aspects that weaken the application. The principles of continuity and teamwork, which are among the principles of curriculum development, state that curriculum development continues continuously during implementation and that the partners of the curriculum are included in the group in the whole process. Therefore, changes in curriculum partners should not affect a systematically progressive curriculum development process (Gültekin, 2017). This opinion of the curriculum specialist does not coincide with these principles of curriculum development.

Teachers have stated that the fact that they want students to attend the workshop for a specified period of time instead of ensuring that they participate in the workshop they want is another weakness of the curriculum. Similar to the teachers' comments, the comments of the administrators and curriculum experts stated that one of the weaknesses

of the curriculum was that the students did not participate in the workshop trainings in their own way. The fact that children do not participate in workshops for their abilities and are not allowed to choose the workshop they want to participate in causes their interest to decrease and classroom management to become difficult. The necessity of problem-based education, content customization, learning the importance of the curriculum with the aim of increasing interest supports the work of Harackiewicz, Smith, and Priniski (2016).

The study showed that it is necessary to ensure that students can participate in workshop activities in the areas they need. Although teachers make some small changes to the curriculum, this is slow compared to the learning speed of the students. While preparing the curriculum to be applied for gifted students, the development of the curriculum contents for the individual abilities of the children and the differentiation of the speed and difficulty according to their levels will increase their interest (Rotigel and Fello, 2004). The need for gifted students to actively participate in challenging activities and to create products in which they can manifest themselves in these activities enables them to move away from situations such as the slow progress of the subjects encountered in standard educational activities and the re-teaching of what they already know and to carry out studies towards their needs (Gallagher, Harradine and Coleman, 1997). Kennedy's (2002) ideas about the need for students to strengthen their social interactions, which he mentioned in his study, coincide with the views of curriculum experts.

The findings show that the students participating in the workshop curriculums do not exhibit behaviors in accordance with the workshop objectives. There are various problems during the activities due to the lack of interest in the workshop activities, their distraction, the lack of pre-requisite skills and the development of prejudices against general education activities. It is necessary to explain the learning objectives to the students and to make curriculum plans at the appropriate speed and variety. These views of teachers emphasize the importance of determining the level of readiness of students. The administrator and curriculum experts mentioned that the students' readiness levels were sufficient. At this point, the opinions of teachers and administrators and curriculum experts contradict each other. Objective and subjective activities such as performance-determining scales, questionnaires identifying areas of need, independent project results, student observations should be carried out to determine the readiness of students. (Callahan, 1986)

Teachers' responses about their professional development show that they care about their own professional development. Teachers involved in the education of students with gifted should have features such as creative thinking, carrying out studies for the student's abilities and skills, and encouraging advanced thinking skills by using appropriate strategies. The fact that teachers develop and research various materials for their workshops, follow their professional development by doing various readings, participate in educational activities and their mastery and self-confidence in the workshop subjects show that the teacher characteristics are sufficient for the implementation of the curriculum. Accessibility of materials and resources is one of the requirements of creative learning environments. Selecting appropriate materials, tools, and other resources leads to increased creative thinking activities (Davies et al., 2013). The views of teachers, administrators and curriculum experts coincide with research on the selection and provision of materials to be used in the workshops (Eker, 2020).

As the workshop activities continued during the working process, positive changes took place regarding the problems. It can be said that these changes are realized thanks to the adaptation of the students to the curriculums, the teachers to know the students better, the strengthening of the teacher-student relations and the better recognition of the workshop objectives by the students. Gifted students; they have difficulty setting goals, communicating effectively interpersonally, and meeting the high expectations of adults (Hennessey, 2004). Factors such as active participation in the activities, the decrease in the warnings of the teachers, the development of the project in the workshop outside the workshop, the increase in attention spans and interest in the workshop activity show that there are positive developments. In the planning for gifted children it is necessary to determine the goals that will be appropriate for the personal characteristics of the children. With the determination of these goals, the formation of a positive classroom environment is supported (Girgin, 2020). The fact that the plans made by the curriculum experts about the course work and processing related to the implementation of the workshop activities are also functional coincides with these views.

In Stufflebeam's CIPP model, evaluations of product size are not only based on product size, but also on all positive and negative aspects of the curriculum and evaluating its effectiveness; the resulting products are addressed to the level of achievement of the targeted objectives at the end of the curriculum and all of the changes that occur in children (Arap, 2016). The main characteristic difference between gifted children and children with normal development is independence (Çalıkoğlu, 2017). The features provided by the workshop trainings, such as making individual products, taking personal roles and acquiring responsibilities, support these characteristic features of children. The opinions of curriculum experts and administrators differ from each other on this point. In the opinions of the curriculum experts, it is stated that the students should participate in all the workshops in order to ensure their development in all areas, and in the opinions of the administrators, it is stated that the child's own choice of the workshop he wants to participate in will ensure that their interests are high.

In this research, the behavioral changes that the studies carried out in the workshop activities in accordance with the objectives of each workshop in children are evaluated and the objectives are achieved. In order to reveal the potential achievements of gifted students, the fact that the evaluation studies are based on the process and product in the workshop activities eliminates the low achievement problem seen in the gifted students. The evaluation model determined in terms of the out-of-school nature of the workshops and the fact that the goal they are based on is more practical instead of teaching theoretical knowledge fits the curriculum. According to the context of Stufflebeam's product evaluation, the evaluation studies are appropriate for the nature of the curriculum and the evaluation system applied in the workshop curriculums coincide with each other. As stated by the curriculum experts, the satisfaction of the parents with the curriculum and their opinions about the success of the curriculum as a result of the examination of the teacher feedback they received support that the evaluation system was done correctly (Hoower-Schultz, 2005).

Recommendations

In the light of the findings obtained, the following recommendations are made to educators and curriculum development experts;

- It is important that the environment arrangements for the workshops to be held are appropriate to the structure of the workshop in terms of the teacher's classroom management and increasing the attention of the students. In this regard, studies should be developed.
- By arranging an area where children can put their finished workshops, the confusion created by these materials can be prevented in the next workshops they will attend.
- Goals should be chosen carefully and should not be raised above the level of ability that children are capable of. Although they have gifted, it is possible to set realistic goals so that the difference between the expected level of success and their actual success does not increase.
- The objectives of the workshop activities can be explained by informing the children before starting the workshop curriculums
- Curriculum evaluations can be made using different evaluation models related to the work of other institutions that provide education about gifted.
- It can be implemented by conducting curriculum development work under the guidance of the evaluation specialist from the curriculum development process to the final evaluation process.
- By planning the recommendations presented in the research, the effectiveness of the planning can be investigated by experimental methods.
- In the workshop curriculum applications, evaluation studies related to the student size can be carried out.

Biodata of the Authors

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Research Article

A thematic content analysis study on concept map oriented graduate theses between 2001 and 2023

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Abstract

The main purpose of this study is to examine the postgraduate theses on concept mapping in terms of purpose and method and to determine the general trends of the studies prepared within the framework of this theme. The data obtained for this purpose were analyzed by thematic content analysis method. The postgraduate theses published on the official website of the National Thesis Center of the Higher Education Institution in Turkey (YÖK TEZ) between 2001 and 2023 on concept mapping were scanned in line with the criteria for inclusion in the study. A total of 116 graduate thesis, 100 master's theses (MT) and 16 doctoral theses (DT), were included in the study. The inclusion criteria were "being within the specified date range", "being concept map-oriented", "being within the Institute of Educational Sciences and Social Sciences". The distribution of the theses within the scope of the research was examined according to the year of publication, type of publication, subject, method/pattern, sample/study group and size, type of data collection tools, data analysis methods and the department/science branch. According to the results of the research, it was determined that the theses examined were mostly aimed at examining the effect of concept maps on student achievement, were predominantly designed in experimental design, the sample/study group was mostly in the range of 51-100 participants, and the sample consisted mostly of primary and secondary school students. It is thought that the main results of this study will provide important clues to researchers working in this field. Within the framework of the results of the research, it can be suggested that different research methods should be utilized in new studies to be conducted in this subject area, especially qualitative studies should be designed to examine the subject.

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Introduction

Scientific and technological developments brought about by our age lead countries to a process of change and transformation in education, social and economic fields. The type of people needed by countries is changing. Qualified individuals who can think critically and analytically, offer creative solutions to the problems brought about by social changes and have high-level thinking skills constitute the type of people that countries need. Raising individuals who can adapt to innovations, access the right information from the rapidly spreading mass of information, and distinguish the right information from the wrong information by approaching information critically is among the educational goals of developed countries. For this reason, countries take these qualifications into consideration when determining their

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educational goals. Education has an important role in raising the type of people that countries need. The places where education and training activities are provided in a planned and programmed manner are schools, which are formal education institutions.

The quality of teaching activities in schools is possible by selecting the right teaching strategies, methods, techniques and approaches to be used according to student needs. In this respect, Ausubel (1968) developed the meaningful learning strategy, which is one of the most important points in education and training and an element that affects learning. According to the meaningful learning strategy, the most important factor affecting learning is the knowledge that the learner has in his/her cognitive structure (Novak & Musonda, 1991). Sönmez (2015) stated that student needs should be taken into account in education and training activities and that information will be learned in a meaningful way by choosing appropriate teaching strategies, methods, techniques and approaches according to these needs. In this context, in order to raise individuals who learn information in a meaningful way, it is important to know how individuals learn and what kind of learning approach they have for the act of learning (Önder & Beşoluk, 2010).

Learning has been a concept that has been studied by many researchers from past to present. In these studies, how learning is realized with which strategies, methods, techniques and approaches, and how meaningful and permanent learning is realized have been among the questions that are frequently sought for answers in the field of education (Özgür & Tosun, 2012). In this context, many approaches explaining learning have been proposed by different researchers to answer these questions. Among these approaches, the prominent ones are the approaches put forward within the framework of behaviorist learning and cognitive learning theories. The meaningful learning strategy proposed by Ausubel draws attention as one of the cognitive learning theories.

The meaningful learning approach is based on learning the information presented to the individual verbally through reception and in a meaningful way. In order for meaningful learning to occur in this sense, firstly, a meaningful learning material that will be meaningful to the students is presented and the learner is expected to associate this meaningful learning material with his/her previous learning. According to this strategy, when these two conditions are met, the learner will be able to create a new meaning in his/her mind about the learning material (Ausubel, 1962).

Novak, Govin and Johansen (1983) state that the key factor in the successful realization of meaningful learning is the prior knowledge/concepts of the individual. They also state that meaningful learning will occur when the new information is consciously connected with the related concepts that already exist in the individual's mind, otherwise the individual will arbitrarily incorporate the new information into the cognitive structure and as a result, rote learning will occur. At this point, it is important to know that unless the information learned by rote learning is repeated, it will be forgotten from long-term memory, misconceptions will be formed in the learner, and there will be no possibility of using the learned information in subsequent learning (Novak & Canas, 2006). Ausubel (1962) states that the meaningful learning approach through reception can be used effectively in learning concepts representing objects and events. In this context, learning starts with concepts (Sönmez, 2015).

Concept Map in Learning-Teaching Processes

Novak developed the concept map method in 1972 in his research in which he aimed to follow the changes in children's knowledge of science and to reveal children's ability to acquire scientific concepts based on Ausubel's theory of meaningful learning (Novak & Canas, 2006).

A concept map is a research, assessment and teaching tool to facilitate meaningful learning in which the most inclusive and general concepts at the top of the map are hierarchically arranged, and more specific concepts are hierarchically organized downwards (Novak, Govin, & Johansen, 1983). Concept maps are visual images of concepts in students' minds (Erdimez, Tan, & Zimmerman, 2017). Freeman and Jessup (2004) defined concept mapping as a technique that allows one person to convey the meaning and relationships between concepts to another person in a visual format. Concept mapping is a learning strategy developed as a research tool to represent students' prior knowledge and then as a tool to enhance meaningful learning (Heinze-Fry & Novak, 1990). Kinchin (2000) emphasizes that a concept map is a highly flexible tool that can be adapted for use by almost any group of students. Concept maps help students internalize important concepts and integrate these concepts with prior knowledge while exploring students'

knowledge levels and misconceptions. It is also known that all knowledge domains can be represented by concept maps and that there is no knowledge or skill domain for which concept maps cannot be used as a representational tool (Novak, 1990).

Considering the definitions provided regarding concept maps, it can be said that concept maps are graphical tools illustrating concepts and the relationships among these concepts, serving as learning tools for students to express what they have learned. Concept maps, which allow information presented to students in graphical ways, facilitate meaningful learning by representing relationships between concepts in the minds of teachers and students, thereby assisting in teaching and learning processes (Santhanam, Leach, & Dawson, 1998).

Novak, Govin, and Johansen (1983) state that concept maps have positive effects on creative thinking skills within higher-order thinking abilities, aiding students in meaningful learning and helping them construct a conceptual understanding of the subject to be taught. Although concept maps require higher-order thinking skills, they are a practical tool that can be used at various educational levels to certain extents. Rice (2000) indicates that the use of concept maps is not limited to any specific group of students. Studies conducted with primary school children demonstrate that even first-grade students can be successful in concept mapping (Novak, Govin, & Johansen, 1983). Gödek, Polat, and Kaya (2018) express that qualified teaching is possible through meaningful learning at the level of concepts, emphasizing that the success of concept teaching lies in using concepts correctly and appropriately, avoiding confusion with other concepts, and establishing accurate relationships between concepts. One of the most effective tools that can be utilized in achieving this outcome is concept maps within teaching practices.

The use of concept maps as a teaching or assessment tool in the field of education spans a long period, thereby covering a broad timeframe in the studies conducted in this field. Within the scope of this research, an examination was carried out on postgraduate thesis studies related to concept maps in Turkey (from 2001 to 2023) in terms of their subject matter and methodological context. The aim was to present an overview from the past to the present, through a content analysis, and contribute to the literature based on the results obtained. Furthermore, no research specifically addressing this area was found in the existing literature, which underscores the significance of the outcomes of this study in contributing to future research in this field. Pursuant to the stated primary objective, the research sought answers to the following questions:

Concept map-focused postgraduate theses in the field of education:

- What is the distribution according to the department/branch of science?
- How is the distribution based on the year of publication?
- What is the distribution according to the type of publication?
- How is the distribution concerning their subjects/topics?
- What is the distribution based on the methodology/design?
- How is the distribution concerning the sampling/participant group?
- What is the distribution based on the size of the sampling/participant group?
- How is the distribution according to the type of data collection tools?
- What is the distribution concerning the data analysis methods?"

Method

Research Design

In this research, the method of thematic content analysis, one of the types of content analysis, has been utilized. This analysis method involves synthesizing and interpreting, critically and as a whole, the trends, findings, and outcomes of studies conducted in a similar field, considering established themes and templates (Finfgeld, 2003). Thematic content analysis allows for the synthesis of common aspects of studies addressing similar topics within a qualitative understanding. In this respect, thematic content analysis is regarded as a rich reference source, enabling researchers who cannot access all studies in their field to reach more extensive research (Çalık, Ayaş, & Ebenezer, 2005; Çalık & Sözbilir, 2014). Due to the in-depth examination in thematic content analysis, a limited number of studies are subjected to

analysis. Hence, in this study, between 2001 and 2023, an in-depth examination of postgraduate theses related to concept maps conducted within domestic education and social sciences institutes was carried out to reveal current trends in the field, thus justifying the preference for thematic content analysis.

Data Collection

Prior to obtaining the data, inclusion criteria and keywords for the research were determined. Subsequently, a search was conducted on the Higher Education Council National Thesis Center (YÖK TEZ) official website using the keyword 'concept map.' A total of 187 postgraduate theses, comprising 29 doctoral theses (DT) and 158 master's theses (MT) related to concept maps between 2001 and 2023, were retrieved through the search engine. The retrieved theses were re-examined in accordance with the inclusion criteria for the research. In determining the theses to be included in the study, the criteria utilized focused on concept map orientation within the framework of the Institute of Education and Social Sciences between 2001 and 2023. According to these criteria, among the included postgraduate theses, 86 were from the Institute of Educational Sciences, 48 from the Institute of Natural Sciences, 43 from the Institute of Social Sciences, six from the Institute of Health Sciences, three from the Graduate School of Education, and one from the Institute of Engineering and Natural Sciences.

In the subsequent stage, a total of 10 theses, consisting of three DT and seven MT from the Institute of Social Sciences, did not fully meet the defined criteria and were therefore excluded from the scope of the study. Additionally, two MT conducted at the Institute of Educational Sciences were excluded from the research as they focused on meta-analysis topics. Consequently, the analysis process continued with a total of 116 postgraduate theses, comprising 100 MT and 16 DT.

Data Analysis

The theses to be subjected to thematic analysis were examined under the titles of 'publication year, level, topic, method/design, sampling/participant group and size, type of data collection tools, data analysis methods, department/branch of science,' and the data were transferred to Excel. The theses included in the study were coded as Doctoral Thesis 1: DT1 and Master's Thesis 1: MT1. To prevent incorrect data entry and any potential data loss, following the entry of research question answers into the Excel table, the researcher and an expert simultaneously compared the data. Following the coding process conducted on the data, themes and sub-themes were identified, and relevant tables were created.

Validity and Reliability

Verification processes regarding the analysis phase and raw data were conducted by both the researcher and an expert, ensuring the reliability of the analysis through result comparisons. In cases where inconsistencies were observed between the researcher's and the expert's opinions, a re-examination was performed to achieve consensus. To ensure the external reliability of the study, all procedural steps were extensively presented in tables in the methodology section. Additionally, data verification processes were recorded both digitally and in print.

Results

In this section of the study, thematic analysis results conducted on the theses included in the research are sequentially presented.

Table 1 provides distribution information of postgraduate theses focused on concept maps according to the publication year.

Table 1. Distribution of postgraduate theses focused on concept maps by publication year

Publication Year Range	Publication Level	f	%
2019-2023	MT	17	80.95
	DT	4	19.05
	Total	21	100.0
2013-2018	MT	19	76.00
	DT	6	24.00
	Total	25	100.0
2007-2012	MT	32	94.12
	DT	2	5.88
	Total	34	100.0
2001-2006	MT	32	88.89
	DT	4	11.11
	Total	36	100.0

As seen in Table 1, the distribution of postgraduate theses examined in this study according to their publication years reveals that the majority of concept map-focused theses (%31.03) were conducted between 2001 and 2006. Among these theses, the majority (%86.21) were master's theses. The distribution in the table also indicates fluctuations in the increase and decrease trends of domestically conducted theses related to concept maps from 2001 to the present. However, it can be stated that the continuity of the subject remains within the scope of researchers' interest. Table 2 illustrates the distribution of theses examined in the study according to their level.

Table 2. Distribution of postgraduate theses focused on concept maps according to their level.

Publication Level	f	%
MT	100	86.21
DT	16	13.79
Total	116	100.00

As seen in Table 2, the distribution of postgraduate theses focused on concept maps examined in this study shows a predominance of MT (%86.21) in this subject area. However, it can be observed that the proportion of DT related to concept maps is not insignificant (%13.79).

Table 3 illustrates the distribution of theses examined in the study according to their topics.

Table 3. Distribution of postgraduate theses focused on concept maps according to their topics

Topic	Thesis Code	f	%
The impact of concept mapping on success (academic achievement, learning the unit/topic, comprehension, learning and academic success, cognitive processes, attainment…)	MT2, MT3, MT4, MT9, MT11, MT12, MT16, MT17, MT19, MT20, MT21, MT23, MT24, MT28, MT30, MT31, MT33, MT34, MT35, MT37, MT40, MT41, MT46, MT48, MT53, MT55, MT58, MT59, MT61, MT62, MT63, MT64, MT67, MT69, MT70, MT71, MT72, MT73, MT74, MT75, MT77, MT78, MT79, MT82, MT84, MT85, MT86, MT88, MT90, MT91, MT93, MT97, MT98, MT99, MT100, DT1, DT2, DT4, DT5, DT6, DT8, DT12, DT13, DT14, DT16	65	38.24
The impact of concept mapping on attitude (towards the course, unit, topic…)	MT9, MT11, MT16, MT28, MT30, MT31, MT34, MT36, MT37, MT40, MT41, MT42, MT46, MT48, MT55, MT56, MT61, MT62, MT63, MT71, MT73, MT76, MT83, MT87, MT94, MT98, DT3, DT5, DT11, DT12, DT14	31	18.24
The impact of concept mapping on the retention of learning (recall of the subject matter, remembering information…)	MT12, MT16, MT23, MT24, MT28, MT31, MT46, MT53, MT55, MT56, MT62, MT63, MT73, MT94, MT99, MT100, DT1, DT5, DT8, DT13, DT16	21	12.35
Concept mapping as an assessment and evaluation tool	MT38, MT45, MT47, MT49, MT52, MT54, MT57, MT60, MT65, MT66, MT67, MT96, DT15	13	7.65
The effect of concept mapping on concept learning (concept development, acquisition, knowledge structures…)	MT14, MT26, MT43, MT50, MT51, MT78, MT97, MT98, DT16	9	5.29
Creating concept maps (Teacher/student knowledge and usage skills in concept mapping, development/creation of concept maps…)	MT7, MT13, MT15 MT 27, MT83, MT92, DT7	7	4.12
The impact of concept maps on fundamental skills (writing, speaking, reading comprehension…)	MT8, MT10, DT3, DT9, DT11	5	2.94
Perceptions regarding the appropriateness of concept map usage (teacher/student perspectives)	MT15, MT22, MT25, DT7	4	2.35
Representation of topics through concept mapping (lessons, programs, texts…)	MT18, MT32, MT81	3	1.76
The influence of concept maps on motivation (impact on motivation towards a course…)	MT76, DT4	2	1.18
The effect of concept maps on anxiety (related to a course, public speaking…)	MT9, MT10	2	1.18
The impact of concept maps on strategy usage	DT14	1	0.59
The effect of concept maps on thinking abilities (geometric thinking…)	MT80	1	0.59
The impact of concept maps on problem-solving skills	MT95	1	0.59
The influence of concept maps on metacognitive skill development	MT1	1	0.59
The effect of concept maps on prediction levels (predicting report card grades and adjusted Student Selection and Placement Test scores…)	MT39	1	0.59
The impact of concept maps on association skills	MT	1	0.59
The effect of concept maps on self-efficacy (course-related self-efficacy)	MT9	1	0.59
The influence of concept maps on mathematical proficiency	MT29	1	0.59

Table 4. Distribution of postgraduate theses focused on concept maps according to the utilized methodology.

Method	Type		Thesis code	f	%
Quantitative	Experimental	Pretest-posttest nonequivalent control group quasi-experimental design	MT2, MT3, MT4, MT9, MT10, MT11, MT12, MT14, MT16, MT17, MT20, MT21, MT24, MT28, MT29, MT30, MT33, MT34, MT35, MT36, MT37, MT38, MT41, MT42, MT46, MT48, MT49, MT53, MT55, MT56, MT58, MT59, MT61, MT62, MT63, MT64, MT67, MT70, MT71, MT72, MT73, MT74, MT75, MT76, MT77, MT78, MT79, MT80, MT82, MT84, MT85, MT86, MT87, MT90, MT91, MT94, MT95, MT97, MT98, MT99, MT100, DT5, DT6, DT10, DT12, DT13, DT14, DT16	68	58.62
		Pretest-posttest nonequivalent control group quasi-experimental design	MT19, DT1	2	1.72
		Comparative single-subject multiple-baseline design across behaviors	MT23, MT43	2	1.72
		Pretest-posttest experimental group quasi-experimental design	MT31	1	0.86
		Posttest control group experimental design	MT66, MT69	2	1.72
	Scanning	Descriptive survey	MT25, MT39, MT45, MT50, MT65, MT83, MT89, MT92, MT93, DT15	10	8.62
		Correlational survey	MT22, MT27, MT51, MT52, MT54 MT96,	6	5.17
Qualitative	Action Research		MT5, MT15, DT9	3	2.59
	Case Study		MT6, MT13, MT44	3	2.59
	Interview		MT47, MT60	2	1.72
	Descriptive		MT18, MT26	2	1.72
	Documentation		MT32, MT68, MT81	3	2.59
Mixed	Embedded Design		DT2, DT4	2	1.72
	Convergent Parallel Design		MT7	1	0.86
	Sequential Explanatory Design		MT8, DT3	2	1.72
	Simultaneous Variation		DT7, DT8	2	1.72
	Other (Mixed but design not specified		MT1, MT40, MT57, MT88, DT11	5	4.31

Table 5. Distribution of postgraduate theses on concept mapping according to the sample/participant group

Sample/Participant Group	Grade Level	Thesis Code	f	%
Primary and Secondary Education	4th grade	MT26, MT43, MT72, MT92, MT94	5	4.00
	5th grade	MT16, MT22, MT57, MT60, MT64, MT72, MT88, MT100, DT14	9	7.20
	6th grade	MT19, MT22, MT23, MT31, MT33, MT36, MT46, MT53, MT54 MT58, MT61, MT62, MT73, MT75, MT76, MT79, MT92, MT97	18	14.40
	7th grade	MT1, MT2, MT10, MT11, MT22, MT25, MT40, MT63 MT71, MT80, MT83, MT86, MT87, MT98, MT99, DT5, DT10, DT13	18	14.40
	8th grade	MT9, MT22, MT26, MT28, MT29, MT30, MT35, MT38 MT39, MT42, MT56, MT78, MT90, MT95, DT4, DT11	16	12.80
	9th grade	MT22, MT34, MT49, MT50, MT67, MT69, MT70, MT82, MT84 MT85, MT91, MT93, MT96	13	10.40
	10th grade	MT21, MT22, MT48, MT50, MT59, MT77, DT1, DT12, DT16	9	7.20
	11th gade	MT17, MT22, MT50, MT74	4	3.20
	12th grade	MT12, MT22, MT26, MT41, MT50, MT65	6	4.80
Total			**98**	**78.40**
University Students		MT3, MT4, MT5, MT6, MT8, MT14, MT20, MT37, MT44, MT51, MT52, MT66, MT89, DT2, DT3, DT6, DT7, DT8, DT9.	19	15.20
Teachers		MT7, MT13, MT15, MT22, MT25, MT27, MT45, MT47	8	6.40
Total			**27**	**21.60**

Note: In cases where studies involve multiple levels of participant groups, coding has been applied to the relevant levels. Additionally, the theses focusing on theoretical aspects of concept mapping are not included in this table

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When examining Table 3, it is observed that the theses predominantly focus on investigating the influence of concept maps on student achievement (38.24%). These studies generally aim to determine the effectiveness of concept maps in aiding students' understanding and learning of the discussed subject matter, their success in the subject, and attainment. Table 4 presents the distribution of theses examined in the study based on the preferred methodology.

According to Table 4, it is evident that among the postgraduate theses focused on concept mapping included in the study, various methods such as quantitative, qualitative, and mixed methods were utilized. However, it was determined that the theses were predominantly designed with quantitative research methods, particularly the experimental method (64.66%). Table 5 displays the distribution of theses examined in the study based on the sample/participant group.

When Table 5 is examined overall, it is observed that among the concept mapping-focused theses studied between 2001 and 2023, the sample/participant groups primarily consisted of primary and secondary education students (78.40%). This was followed by university students (15.20%). This finding indicates that concept mapping studies are predominantly conducted with student groups in primary and secondary education levels, yet studies involving teachers and teacher candidates are also present. Furthermore, an analysis was conducted regarding the sample/participant group sizes of the examined theses and the data were tabulated.

Table 6 demonstrates the distribution of postgraduate theses focused on concept mapping according to the sample/study group sizes.

Table 6. Distribution of postgraduate theses focused on concept mapping by sample/study group size

Sample/Participant Group Size	Thesis Code	**f**	**%**
1-10 participant	MT23, MT43	2	1.77
11-30 participant	MT5, MT13, MT14, MT15, MT31, MT38, MT47, MT54 MT62, MT93 MT96, DT7, DT9	13	11.50
31-50 participant	MT1, MT2, MT6, MT8, MT10, MT12, MT19, MT21, MT24, MT33, MT35 MT40, MT41, MT44, MT53, MT56, MT63, MT66 MT70, MT74, MT75 MT84, MT90, MT95, DT2, DT3	26	23.01
51-100 participant	MT3, MT9, MT11, MT16, MT20, MT25, MT28, MT29, MT30, MT34 MT36, MT42, MT45, MT48 MT49, MT58, MT59, MT60, MT61, MT64 MT67, MT71 MT73, MT77, MT78, MT79, MT82, MT83, MT85, MT86 MT88, MT89, MT91, MT94, MT97, MT100, DT1, DT4, DT5, DT6, DT8, DT10, DT12, DT13	44	38.94
101-150 participant	MT17, MT37, MT39, MT46, MT52, MT57, MT65, MT69, MT72, MT80 MT87, MT98, DT11, DT14, DT16	15	13.27
151-200 participant	MT4, MT7, MT26, MT92, MT99	5	4.42
201-400 participant	MT50, MT51, MT76, DT15	4	3.54
401-500 participant	MT27	1	0.88
700-850 participant	MT22	1	0.88
Toplam		113	100

Not: Additionally, the theses that theoretically approach the concept map are not included in this table.

When Table 6 was examined, it was revealed that among the theses related to concept maps, the most prevalent sample/participant group size falls within the range of 51-100 participants (38.94%), whereas the smallest sample/participant group size (0.88%) falls within the range of 401-700 participants. Table 7 presents the results of the examination based on the data collection tools used in the theses.

Table 7. Distribution of data collection tools in postgraduate theses focused on concept mapping

Assessment Tools		Thesis Code	f	%
Scale	Attitude Scale	MT9 MT16, DT1, DT3, DT7 MT28 MT30 MT31, MT34, MT36, DT11, MT37, MT40, MT41, MT42, MT46, MT48, DT12, DT5, MT55, MT56, MT61, MT62, MT63, MT71, MT73, MT76, DT13, MT77, MT79, MT83, DT14, MT87, MT94, MT98	35	18.32
	Metacognitive Awareness Scale	MT1	1	0.52
	Transcognitive Skills Scale	MT1	1	0.52
	Anxiety Scale	MT9, MT10	2	1.05
	Self-Efficacy Perception Scale	MT9	1	0.52
	Opinion Scale	DT5	1	0.52
	Attrition Scale	DT6	1	0.52
	Power Scale	MT29	1	0.52
	Motivation Scale	MT76	1	0.52
	Learning Style/Strategy Scale	MT83, DT14	2	1.05
Survey		DT4, MT7 MT25 MT27 DT8, MT33, DT11, MT38, MT46, MT50, MT69, MT70, DT13, MT88	14	7.33
Test	Achievement Test	MT1, DT3, DT2, DT4, MT2, MT3, MT4, MT9, MT11 MT16, MT12, MT14, MT17, MT20 MT19 MT21 MT24, DT5, DT6 DT7 MT28 DT8, DT9 MT30 DT10, MT33, MT34, MT35, MT36, DT11, MT37, MT38, MT39, MT41, MT42, MT46, MT48, MT49, MT51, MT52, MT53, DT12, MT54, MT55, MT56, MT57, MT58, MT59, MT61, MT62, MT63, MT64, MT65, MT66, MT67, MT70, MT71, MT72, MT73, MT74, MT75, DT13, MT77, MT78, MT79, MT80, MT82, MT84, DT14, MT85, MT86, MT87, MT88, MT90, MT91, MT92, MT93, MT94, MT95, DT15, MT97, MT98, DT16, MT99, MT100	85	44.50
Interview	Semi-Structured Interview Form	DT1 DT2 DT3 MT8 MT10 MT13 MT15 MT24 MT29, MT36, DT11, MT40, MT44, MT47, MT53, MT60, MT64, MT73, DT13, MT87, Y88	21	10.99
	Unstructured Interview Form	MT5, MT6	2	1.05
	Pre/Post Interview Form	MT5, MT13	2	1.05
	Focus Group Interview Form	DT2	1	0.52
Observation	-	DT1, MT13, DT9, MT43, MT64	5	2.62
Video/Audio Recording	-	DT9, DT13, MT88	3	1.57
Documentation	-	MT18, MT22, MT32, MT45, MT65, MT68, MT81, MT89	8	4.19
Diary	-	MT1 MT13 DT7, DT9	4	2.09

According to Table 7, when the postgraduate theses focused on concept mapping are examined in terms of data collection tools, there is a general diversity observed in the studies, yet quantitative methods are predominantly used. Success tests, scales, and interviews are frequently preferred as data collection tools, while documentation, observation, diaries, video/audio recordings are identified as the least used tools. On the other hand, it is observed that in theses focused on concept maps, the subject is examined in relation to different dimensions, hence the used data collection tools are not exclusively related to concept maps.

The distribution of the theses examined within the scope of this study in terms of Department/Branch of Science is presented in Table 8.

Table 8. Distribution of Postgraduate Theses on Concept Mapping by Department/Branch of Science

Department/Branch Code	Postgraduate Theses	f	%
Elementary Education Department, Science Education Branch	MT26, MT36, MT37, MT42, MT55, MT56, MT61, MT63, MT71, MT73, MT78, MT79, MT83, MT87, MT89, MT90, MT94, MT95, MT97, MT98, MT99, DT5, DT10	23	19,83
Turkish and Social Sciences Education Department, Turkish Education Branch	MT10, DT2, DT3, MT14, MT18, MT33, MT68, DT9, DT11, DT13	10	8.62
Educational Sciences Department, Educational Programs and Instructional Sciences Branch	MT3, MT16, MT29, MT62, MT76, MT84, MT93, DT14	8	6.90
Secondary Education Science and Mathematics Fields Education Department, Biology Education Branch	MT12, MT20, MT34, MT38, MT41, MT67, MT85, DT12	8	6.90
Secondary Education Science and Mathematics Fields Education Department, Chemistry Education Branch	DT1, DT4, MT48, MT49, MT82, DT7, DT8	7	6.03
Educational Sciences Department, Measurement and Evaluation in Education Branch	MT39, MT40, MT45, MT52, MT57, DT15	6	5.17
Elementary Education Department, Mathematics Education Branch	MT9, MT280, MT51, MT54, MT80, MT96	6	5.17
Mathematics and Science Education Department, Mathematics Education Branch	MT1, MT2, MT5, MT11, MT13	5	4.31
Secondary Education Social Sciences Education Department, Geography Education Branch	MT21, MT59, MT69, MT91	4	3.45
Computer and Instructional Technologies Education Department	MT4, MT22, MT92, DT6	4	3.45
Educational Sciences Department, Educational Administration and Supervision Branch	MT47, MT65, MT74, DT16	4	3.45
Elementary Education Department, Elementary Classroom Teaching Branch	MT27, MT30, MT35, MT64	4	3.45
Elementary Education Department, Social Studies Education Branch	MT31, MT46, MT75, MT88	4	3.45
Educational Sciences Department, Educational Program Development Branch	MT60, MT70, MT100	3	2.59
Elementary School Mathematics Teaching Department	MT24, MT53, MT58	3	2.59
Secondary Education Science and Mathematics Fields Education Department, Physics Education Branch	MT44, MT50, MT66	3	2.59
Turkish and Social Sciences Education Department, Geography Education Branch	MT15, MT25	2	1.72
Mathematics and Science Education Department, Chemistry Education Branch	MT6, MT17	2	1.72
Secondary Education Social Sciences Education Department, History Education Branch	MT77	1	0.86
Secondary Education Social Sciences Education Department, Turkish Language and Literature Teaching Program	MT32	1	0.86
Philosophy and Religious Sciences Department, Religious Education Branch	MT81	1	0.86
Fine Arts Education Department, Fine Arts Teaching Branch	MT86	1	0.86
English Language Education Department	MT8	1	0.86
Special Education Department, Education of Mentally Disabled Branch	MT23	1	0.86
Special Education Department, Special Education Branch	MT43	1	0.86
Physical Education and Sports Teaching Department, Sports Education Branch	MT72	1	0.86
Basic Education Department, Preschool Teaching Branch	MT7	1	0.86

Turkish and Social Sciences Education Department, Social Studies Education Program	MT19	1	0.86
Total		116	100

When examining the distribution of theses by Department/Branch of Science in Table 8, it is determined that the theses on the topic of concept mapping are most prevalent in the field of Science Education (%19.83). However, it is also observed that there are a few theses focused on concept mapping in various other fields (Department/Branch of Science).

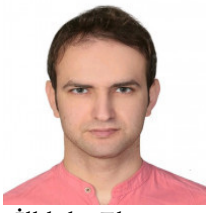
Conclusion and Discussion

The results obtained from this research aimed at determining the general trends of postgraduate theses related to concept mapping in terms of subject and methodology dimensions are detailed in the findings section of the study. One of the findings reached in this study is that the majority of theses related to concept mapping were prepared as MT between 2001 and 2006. Günhan (2009) supports this finding by stating that the majority of studies aiming to reveal the effect of concept mapping on success were conducted in 2006. The examined thesis studies mostly aimed to reveal the impact of concept mapping on success. For this purpose, theses mostly preferred the semi-experimental design of unequal pre-test and post-test from quantitative research methods. Another result of the research indicates that between 2001 and 2023, postgraduate theses related to concept mapping examined the subject in all levels of education, and were predominantly conducted on primary and secondary school students. However, it is observed that there is insufficient research on the topic at the primary school level.

Recommendations

Based on the results of the study, concept mapping-focused studies can be examined with unexplored dimensions, and qualitative research can be conducted on participants' views, applications, and experiences related to concept maps.

Biodata of the Authors



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Appendix 1. Studies evaluated in the research

No.	Imprint
MT1	Filik, H., N. (2022). *The effect of mathematics teaching by the computer aided concept map on the metacognition skills of 7th grade students.* Master Thesis. Ömer Halis Demir University, Niğde, Turkey.
MT2	Şekerci, H. (2021). *The effect of teaching with concept maps on seventh grade students' achievement and making connection skills regarding polygons.* Master Thesis. Hacettepe University, Ankara, Turkey.
MT3	Yazıcı, E. (2020). *The effect of using concept maps as advance organizers in english lessons on the academic achievement of undergraduate students.* Master Thesis. Yıldız Teknik University, İstanbul, Turkey.
MT4	Polan, Ş. (2020). *Investigation of the effect of static, animated and interactive concept maps on multimedia learning.* Master Thesis. Ege University, İzmir, Turkey.
MT5	Köken, C., B. (2020). *Investigation of the effect of static, animated and interactive concept maps on multimedia learning.* Master Thesis. Bartın University, Bartın, Turkey.
MT6	Bulut, L., Ö. (2020). *Determination of misconceptions of chemistry teacher candidates about solution and solubility with concept maps technique.* Master Thesis. Gazi University, Ankara, Turkey.
MT7	Akpolat, E., Ş. (2019). *Investigation of the relationship between the teacher's knowledge of using consept maps and their applications of concept maps.* Master Thesis. İstanbul Aydın University, İstanbul, Turkey.
MT8	Sebit, S. (2019). *Individual and collaborative computerized concept mapping as a pre-writing strategy: Effects on EFL students' writing.* Master Thesis. Boğaziçi University, İstanbul, Turkey.
MT9	Güleç, D. (2019). *Teaching of exponential numbers with concept and mind maps.* Master Thesis. Necmettin Erbakan University, Konya, Turkey.
MT10	Aydoğan, Y. (2019). *Effect of concept maps on speaking anxiety and improvement of speaking skills of secondary school students*. Master Thesis. Kütahya Dumlupınar University, Kütahya, Turkey.
MT11	Kaya, S. (2019). *The effect of concept map usage on the academic achievement and attitude of student's in teaching secondary school 7th grade rational numbers*. Master Thesis. Fırat University, Elazığ, Turkey.
MT12	Öztürk, H. (2019). *The effect of concept maps on the teaching of biology course about substance transport in plants subject secondery 12 th grade students' achievement and recall level.* Necmettin Erbakan University, Konya, Turkey.
MT13	Döner, M. (2019). *An in-service training activity designed for mathematics teachers for developing a concept map.* Master Thesis. Dicle University, Diyarbakır, Turkey.
MT14	Zorpuzan, R. (2019). *The effect of the consept mapping on vocabulary teaching in teaching language as a foreign language*. Master Thesis. Abant İzzet Baysal University, Bolu, Turkey.
MT15	Can, N. (2019). *Evaluation of the suitability of 9th grade geography subjects in terms of concept map use with teachers' views (Konya case).* Master Thesis. Necmettin Erbakan University, Konya, Turkey.
MT16	Yılmaz, D., U. (2019). *Effects of conducting concept map method in mathematic education to students' success, behavior and remembrance*. Master Thesis. Marmara University, İstanbul, Turkey.
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MT18	Pınar, F., N. (2018). *Presentation of theoretical knowledge about the importance of concept maps and comprehension skill in Turkish teaching with concept map varieties*. Master Thesis. Selçuk University, Konya, Turkey.
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Research Article

Examination of the number sense performance of gifted students in terms of various variables

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Abstract

In this study, it is aimed to examine performance of number sense of gifted students in terms of gender, grade levels,number sense self-efficacy and number sense components. In line with the studies in the literature, due to the insufficent research on the number sense on students who diagnosed with special talents in our country, it is felt that in this research we need to study with these student and examine the level of student of this category in the scope of relevant study in terms of various variables. A quantitative descriptive research model was used to determine carefully and completely the level of students' number sense and their existing situations that is related to it. The study group consists of 6th and 7th-grade students attending Science and Art Centers located in 12 provinces in the Eastern Anatolia Region during the 2022-2023 academic year .286 students attended in this research that included 184 students in the 6th grade and 102 students in the 7th grade. This study included the Number Sense Scale and the Number Sense Self-Efficacy Scale as a data collection tools. It is indicated that in this research students diagnosed with special abilities didn't show high level of number sense performance; instead, they prefer rule-based solutions.It is revealed that , the component "flexibility in calculation" is the most succeded one among the components of number sense.When the students' grade level increases, it has been observed that , the number sense performance of students improves.When number sense performance was examined based on gender, it was seen that male students used number sense more than female students.When the relationship between the number sense test scores and number sense self-efficacy scores of gifted students was examined, an expressive positive correlation was found between the scores.

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Introduction

Numbers and arithmetic form the foundation of the mathematics course. However, arithmetic has long been considered as the basic four operations without attempting to make sense of it, remaining limited to standard algorithms as in the past (Şahin, 2019). Mathematics is not a discipline where rules are memorized and directly applied; it is an area where individuals develop their own methods to solve encountered problems, examine whether the methods they apply

lead to an appropriate solution, and question the meaningfulness of the obtained answers (Van De Walle, Karp, & By-Williams, 2012: 13). However, it is observed that during the solution process, students tend to focus more on the

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outcome rather than the process, use their computational skills without thinking critically, employ written algorithms without generating logical ideas, and frequently arrive at incorrect results (Harç, 2010; Kayhan Altay, 2010; İymen, 2012).

Howden (1989) emphasized that number sense is a significant intuition for students to engage in mathematics, allowing them to consider multiple ways of solving problems and logically evaluate their solutions. McIntosh, Reys, and Reys (1992) defined number sense as the ability to flexibly construct logical reasoning, develop useful strategies related to numbers and operations. Markovits (1989) interpreted number sense as the skill to solve problems that cannot be overcome with rule-based solutions or those that can be solved by rules more easily and efficiently without applying the rules. Within the elementary and middle school mathematics curriculum, the concept of number meaning is considered a crucial topic (Jordan et al., 2010; Dyson, Jordan, & Glutting, 2013). Therefore, examining and interpreting the number meanings in students' minds becomes crucial in this context.

Studies examining number sense reveal that students often exhibit low number sense performance and generally prefer rule-based solutions (Alsawaie, 2012; Yang, 2005; Yang, Li, & Li, 2008; Kayhan Altay, 2010; İymen, 2012; Harç, 2010). These studies have predominantly attempted to understand and evaluate number sense comprehensively by addressing its components alongside number sense itself (Menon, 2004; Facun & Nool, 2012; Reys, Kim, & Bay, 1999; Doğan & Paydar, 2020; Tunalı, 2018). Additionally, research exists where students' number sense performance is considered in relation to their number sense self-efficacy (Çaylı Suel, 2019; Yarar, Es, & Gürefe, 2018), grade level (Singh, 2009; Şahin, 2009; Mohamed & Johnny, 2010), and gender (Er & Artut, 2017; Peker, 2019; Yenilmez & Yıldız, 2018). Studies conducted both in our country and abroad have generally been carried out with undiagnosed students. However, the educational system is multidimensional, where each individual within the system is not at the same level, and there exist individual differences. Among observed groups of students with individual differences are those who exhibit special abilities. Çepni, Gökdere, and Bacanak (2004) have mentioned that individuals diagnosed with special abilities possess qualities such as being creatively above average, having artistic talent, assuming leadership roles, or achieving high success in any academic field, and furthermore, they are capable of taking these qualities to a more advanced level. Based on studies in the literature, due to the inadequacy of research on number sense among students diagnosed with special abilities in our country, there is a felt need in this current study to work with students diagnosed with special abilities to examine their levels in the relevant subject area regarding various variables. It is considered important to determine the level of number sense skills among individuals diagnosed with special abilities and to examine the relationship of their number sense performance with identified variables. In this regard, it is believed that examining the number sense performance of individuals diagnosed with special abilities, especially in terms of their number sense self-efficacy, will significantly fill the gap in the current literature on number sense. This study differentiates itself from existing studies on number sense by focusing on students diagnosed with special abilities. It will provide a basis for future studies on the relationship between number sense and number sense self-efficacy in individuals diagnosed with special abilities. Moreover, it is believed that this study will shed light on educators by encouraging students to use number sense strategies rather than relying predominantly on rule-based approaches in problem-solving. In this study, it is aimed to determine the number sense levels of students diagnosed with special abilities studying at Science and Art Centers (Bilsem) located in the provinces of Ağrı, Erzurum, Bingöl, Ardahan, Bitlis, Elâzığ, Hakkari, Iğdır, Muş, Tunceli, Van, and Kars, and to examine their number sense performance in terms of gender, grade, number sense components, and number sense self-efficacy. The problem of this research is defined as "How do the number sense performances of students diagnosed with special abilities differ in terms of various variables?" In line with this, the following sub-problems are addressed:

- At what level are the number sense skills of students diagnosed with special talents?
- Do the number sense scores of students diagnosed with special talents show a significant difference concerning the gender variable?
- Do the number sense scores of students diagnosed with special talents show a significant difference concerning the class variable?

- How do the number sense averages of students diagnosed with special talents vary according to the subcomponents of numerical sense?
- Do the number sense self-efficacy scores of students diagnosed with special talents show a significant difference concerning the class variable?
- Do the number sense self-efficacy scores of students diagnosed with special talents show a significant difference concerning the gender variable?
- Is there a significant relationship between the number sense test scores and numerical sense self-efficacy scores of students diagnosed with special talents?

Method

Research Design

The model for this research is determined as a quantitative "descriptive survey design" since it aims to determine the number sense levels of individuals diagnosed with special abilities and to examine their number sense performances concerning grade level, gender, number sense components, and number sense self-efficacy variables. A survey research aims to collect data to identify and interpret the current characteristics of a group. The survey model typically involves working with larger samples compared to other research types, aiming to determine opinions or skill, interest, and attitude characteristics related to an event or subject (Büyüköztürk et al., 2018:184).

Study Group

In this research, students from the 6th and 7th grades attending Science and Art Centers in Ağrı, Erzurum, Bingöl, Ardahan, Bitlis, Elâzığ, Hakkari, Iğdır, Muş, Tunceli, Van, and Kars during the 2022-2023 academic year were included. An appropriate sampling method was used for the ease of implementation and to increase the collected data. If the researcher creates the required sample group starting from an easily accessible group in terms of workforce and time, it is an appropriate sampling method (Büyüköztürk et al., 2016). The distribution of the sample according to demographic variables used in the research is indicated in Table 1.

Table 1. Distribution of demographic variables in the sample

Variables		**f**	**%**
Gender	Girl	129	45.1
	Boy	157	54.9
Grade	6th grade	184	64.3
	7th grade	102	35.7
	Total	286	100.0

Data Collection Instruments

In order to examine the number sense performance of middle school-level students diagnosed with special abilities, the Number Sense Scale developed by Kayhan Altay and Umay (2013) was utilized in this study. The reliability of the scale was determined by calculating the Kuder-Richardson Formula 20 (Kr-20), yielding a value of 0.742. The Kr-20 calculation was considered appropriate as items were measured in binary format, and the obtained value above 0.70 indicates the scale's reliability (Büyüköztürk, 2019).

To determine the number sense self-efficacy of students diagnosed with special abilities, the Number Sense Self-Efficacy Scale developed by Alkaş Ulusoy and Şahiner (2017) was employed. A reliability study of the scale was conducted using Cronbach's alpha coefficient, resulting in a value of 0.825. Since the used test was scored on a 5-point Likert scale, internal consistency was considered as an indicator of reliability. As the calculated value exceeded 0.7, the test was assumed to be reliable for this study (Büyüköztürk, 2019).

Data Analysis

Upon examining the responses given by students diagnosed with special abilities in the number sense test, scoring was conducted based on whether they employed number sense strategies. During the assessment phase, students using

number sense strategies were assigned a score of 1, while those who applied rule-based operations without using number sense strategies were assigned a score of 0 (Kayhan Altay and Umay, 2013). The data, coded as 0 and 1, was transferred to the SPSS program for analysis.

In this study, which addressed the number sense test achievements and number sense self-efficacy of students diagnosed with special abilities, the first step involved the analysis of data normality. Median and mean values, Q-Q plots, boxplots, Kolmogorov-Smirnov, and Shapiro-Wilk tests were examined, revealing that the data did not exhibit a normal distribution. Non-parametric tests, specifically the Mann-Whitney U test for comparing scores between two groups and Spearman's Rank-Order Correlation Coefficient for calculating the relationship between variables, were utilized in the data analysis.

Findings

The study aimed to determine the number sense levels of students diagnosed with special abilities and to examine their number sense performances concerning various variables. Based on the answers provided by students, the following findings were obtained:

The first sub-problem of the research, 'What is the level of number sense skills among students diagnosed with special abilities?' is addressed. Table 2 presents the averages obtained from the number sense achievement test of students diagnosed with special abilities.

Table 2. Average number sense scores of students diagnosed with special abilities

	Number Sense
Lowest Score	0
Highest Score	15
Average	5,82
Standard Deviation	3,18

Upon reviewing Table 2, in this study, a total of 286 students participated, and the average score obtained by the participants from the number sense scale is 5.82 out of 15 points. The average scores and standard deviations that students diagnosed with special abilities obtained from each question in the number sense test are presented in Table 3.

Table 3. Average scores and standard deviations obtained by students diagnosed with special abilities from the items of the number sense test

Item number	$\overline{X}$	**ss**
1	0,56	0,50
2	0,13	0,33
3	0,54	0,50
4	0,55	0,50
5	0,33	0,47
7	0,65	0,48
8	0,20	0,40
10	0,23	0,42
11	0,31	0,46
12	0,59	0,49
13	0,27	0,44
14	0,30	0,46
15	0,36	0,48
16	0,65	0,48
17	0,18	0,38

Upon examining Table 3, it is observed that the participants' averages vary between 0.13 and 0.65 on a question-by-question basis. Students solved 38.8% of the questions using number sense strategies in the test. Based on these findings, it can be inferred that students diagnosed with special abilities tend to prefer developing solutions based on rules rather than using number sense strategies.

When examining the number sense averages per question, the highest average was achieved in questions 7 and 16. While question 7 pertains to flexibility in computation, question 16 focuses on the use of comparison (reference) points. The lowest average was obtained in question 2, which is also related to the use of comparison (reference) points.

The second sub-problem of the research is 'Do the number sense scores of students diagnosed with special abilities show a significant difference concerning the variable of grade?' The differentiation of number sense test scores among students diagnosed with special abilities concerning the grade variable was analyzed using the Mann-Whitney U test due to the non-normal distribution of the data. The results obtained from this analysis are indicated in Table 4.

Table 4. The differentiation of number sense test scores among students diagnosed with special abilities concerning the variable of grade

Test	Grade	N	Mean rank	Rank Sum	U	Z	p
Flexibility in computation	6th grade	184	123,24	22675,50	5655,5	-5,637	.000
	7th grade	102	180,05	18365,50			
Conceptual thinking in fractions	6th grade	184	126,29	23237,00	6217	-4,873	.000
	7th grade	102	174,55	17804,00			
Use of comparison (reference) points	6th grade	184	128,95	23727,50	6707,5	-4,211	.000
	7th grade	102	169,74	17313,50			
Total	6th grade	184	121,25	22310,00	5290	-6,136	.000
	7th grade	102	183,64	18731,00			

When examining Table 4, a significant differentiation is observed in the total and components of the number sense test scores of students diagnosed with special abilities concerning the variable of grade [$U_{\text{Flexibility in Calculation}}$ =5655.5, z=-5.637, p<0.05; $U_{\text{Conceptual Thinking with Fractions}}$ =6217, z=-4.873, p<0.05; $U_{\text{Comparison Point Usage}}$ =6707.5, z=-4.211, p<0.05; U_{Total}=5290.00, z=-6.136, p<0.05]. Upon examining the mean ranks of the total number sense test scores and component scores concerning the grade variable, a significant difference in favor of 7th-grade students compared to 6th-grade students is evident.

The third sub-problem of the research is: 'Do the numerical sense scores of students diagnosed with special talents show a significant difference based on the gender variable?' The differentiation of number sense test scores of students diagnosed with special talents based on the gender variable was analyzed using the Mann Whitney U Test due to the data not showing a normal distribution, and the results are indicated in Table 5.

Table 5. Status of differentiation in number sense test scores of students diagnosed with special talents concerning the gender variable.

Test	Gender	N	Mean Rank	Rank Sum	U	Z	p
Flexibility in calculation	Girl	129	126,47	16314,00	7929	-3,198	0,001
	Boy	157	157,50	24727,00			
Conceptual thinking in fractions	Girl	129	146,86	18945,00	9693	-0,642	0,521
	Boy	157	140,74	22096.00			
Use of comparison (reference) points	Girl	129	131,14	16917,50	8532,5	-2,414	0,016
	Boy	157	153,65	24123,50			
Total	Girl	129	131,29	16936,00	8551,0	-2,273	0,023
	Boy	157	153,54	24105,00			

When examining Table 5, a significant differentiation in the total and components specifically, 'Flexibility in Calculation' and 'Use of Comparison Point' of number sense test scores among students diagnosed with special talents is observed based on the gender variable [$U_{\text{Flexibility in Calculation}}$ = 7929, z = -3.198, p < 0.05; $U_{\text{Conceptual Thinking with Fractions}}$ =9693, z = -0.642, p > 0.05; $U_{\text{Comparison Point Usage}}$ = 8532.5, z = -2.414, p < 0.05; UTotal = 8551, z = -2.273, p < 0.05]. Upon examining the rank means of the total scores of number sense tests and the scores of components 'Flexibility in Calculation' and 'Use of Comparison Point' based on the gender variable among students diagnosed with special talents, it is evident that there is a significant favoritism towards male students compared to female students.

The fourth sub-problem of the research is 'How do the number sense averages of students diagnosed with special talents vary according to the subcomponents of numerical sense?' Table 6 presents the numerical sense averages for each subcomponent.

Table 6. Distribution of number sense score averages of students diagnosed with special talents across number sense components

Components	Number Sense Averages
Flexibility in calculation	2,99
Conceptual thinking in fractions	1,55
Use of comparison (reference) points	1,27

According to Table 6, when examining the number sense score averages based on components, the component with the highest achievement is 'flexibility in calculation' (2.99). The component where students diagnosed with special talents show the least achievement is 'use of comparison (reference) point' (1.27).

The fifth sub-problem of the research is 'Do the number sense self-efficacy scores of students diagnosed with special talents show a significant difference concerning the class variable?'The differentiation of number sense self-efficacy scores of students diagnosed with special talents concerning the class variable was analyzed using the Mann Whitney U Test due to the data not showing a normal distribution, and the results are indicated in Table 7.

Table 7. Status of differentiation in number sense self-efficacy scores of students diagnosed with special talents concerning the class variable

Test	Grade	N	Mean Rank	Rank Sum	U	Z	p
Total	6th Grade	184	140,14	25786,00	8766	-0,923	0,000
	7th Grade	102	149,56	15255,00			

Upon examining Table 7, it is observed that there is a significant differentiation in the number sense self-efficacy scores of students diagnosed with special talents concerning the class variable [UTotal=8766, z=-0.923, p<0.05].

The sixth sub-problem of the research is 'Do the number sense self-efficacy scores of students diagnosed with special talents show a significant difference concerning the gender variable?'The differentiation of number sense self-efficacy scores of students diagnosed with special talents concerning the gender variable was examined using the Mann Whitney U Test due to the data not demonstrating a normal distribution, and the results are indicated in Table 8.

Table 8. Status of differentiation in number sense self-efficacy scores of students diagnosed with special talents concerning the gender variable

Test	Gender	N	Mean Rank	Rank Sum	U	Z	p
Total	Girl	129	127,10	16396,50	8011,5	-3,041	0,002
	Boy	157	156,97	24644,50			

Upon examining Table 8, there is observed to be a significant differentiation in the number sense self-efficacy scores of students diagnosed with special talents concerning the gender variable [U=8011.5, z=-3.041, p<0.05]. Upon examining the rank means of the total scores of number sense self-efficacy based on the gender variable among students

diagnosed with special talents, it is evident that there is a significant favoritism towards male students compared to female students.

The seventh sub-problem of the research is 'Is there a significant relationship between the number sense test scores and number sense self-efficacy scores of students diagnosed with special talents?' The Spearman Rank-Order Correlation Coefficient was calculated to determine whether there is a significant relationship between the numerical sense test scores and numerical sense self-efficacy scores of students diagnosed with special talents, and the results obtained from the test are provided in Table 9 .

Table 9. Relationship between number sense test scores and numerical sense self-efficacy scores of students diagnosed with special talents

	Sub-Dimensions	**1**	**2**	**3**	**4**	**5**
1	Flexibility in calculation	1				
2	Conceptual thinking in fractions	0,512**	1			
3	Use of comparison (reference) points	0,492**	0,413**	1		
4	Number Sense Scale total score	0,893**	0,772**	0,720**	1	
5	Number Sense Self-Efficacy	0,292**	0,201**	0,224.**	0,301**	1

According to Table 9, there is a significant positive correlation between the 'Number Sense Scale' total score and the 'Number Sense Self-Efficacy' total score of students diagnosed with special talents (r=0.301).

Conclusion and Discussion

Number Sense

When examining the number sense performance of students diagnosed with special abilities, it was revealed that they scored an average of 5.82 out of 15 on the number sense achievement test. Students solved approximately 38.8% of the questions using number sense strategies. An analysis of their solutions indicated their inadequacy in mental computation and generating flexible strategies for problem-solving. It was observed that they often attempted to solve problems using rule-based approaches. This inclination towards rule-based solutions aligns with previous studies (Alsawaie, 2012; Yang et al., 2005; Yang et al., 2008; Şengül & Gülbağcı, 2013; Kayhan, 2010), indicating a preference for rule-based solutions over number sense strategies. Similarly, İymen (2012) found that students utilized number sense strategies only when asked for shortcuts, generally preferring rule-based solutions. This tendency might stem from the habituation of relying on rule-based approaches during problem-solving sessions in classes. Studies suggest that the prevalent use of written materials by teachers and their inclination towards rule-based approaches during lessons (Purnomo et al., 2014), as well as the evaluation of students with questions that tend to follow rule-based solutions rather than questions that encourage interpretation (Eraslan, 2009), contribute to lower number sense performance among students.

When examining students' number sense performance based on components, it was found that the most successful component with an average of 2.99 was 'Flexibility in Calculation.' The flexibility in calculation component is regarded as choosing the easiest way in operations and seeking solutions that make problems more practical by recognizing various representations of numbers (Kayhan, 2010). Upon analyzing students' solutions, it was observed that there were few students struggling with the equivalence of 0.25 to 1/4. Similarly, studies suggesting that students are approaching the desired level in 'Understanding and Using Number Equivalents' (Doğan & Paydar, 2020) and demonstrating good numerical knowledge, enabling flexible operations (Tunalı, 2018), support the findings of our research.

The component where students showed the least success in the study is 'Comparison (Reference) Point Usage.' Existing literature suggests that students often struggle with the use of reference points and encounter difficulties in developing number sense strategies related to this component (Kayhan, 2010; İymen, 2012; Menon, 2004; Facun & Nool, 2012). Under this component, students are expected to use halves and quarters as reference points to make operations more practical. However, upon reviewing students' solutions, it was observed that they mostly attempted to reach a solution by equalizing denominators. Similarly, in a study conducted by Reys, Kim, and Bay (1999), when

comparing fractions, students generally preferred to equalize denominators or create equivalent fractions rather than using reference points for comparison.

When the number sense test scores of students diagnosed with special talents were examined based on the class variable, a significant difference was found in favor of 7th-grade students over 6th-grade students. This suggests that as students receive more mathematics education and progress through grades, their number sense develops. It could be inferred that the increase in age and the expansion of subject knowledge predispose students to use number sense strategies. This result aligns with studies indicating that number sense levels increase as students advance through grades in research conducted with typically developing students (Tunalı, 2018; Şengül & Gülbağcı, 2013). Findings from Mohamed and Johnny (2010) and Kayhan's (2010) studies suggest that as grade levels increase, there is a tendency to apply standard procedures more and a decrease in the use of number sense. Kayhan (2010) explained this phenomenon by stating that although students engage with the concept of number sense at a young age, as their technical knowledge in mathematics increases, they tend to adopt more rule-based strategies and reduce the use of number sense strategies.

When the number sense test scores of students diagnosed with special talents were examined according to the gender variable, a significant difference was observed in favor of male students over female students. This aligns with the findings of Şahin (2019) and Singh (2009), indicating that male students tend to use number sense more than female students. However, Yenilmez and Yıldız (2018) obtained the opposite result, suggesting that in their research, female students had better number sense compared to male students. Additionally, there are studies in the literature indicating that there is no difference in number sense scores based on gender (Menon, 2004; Er & Artut, 2017; Peker, 2019).

Numerical Sense Self-Efficacy

When examined according to the class variable, a significant difference in favor of the 7th grade students was observed in the number sense self-efficacy scores of students who have been diagnosed with special talents. This result indicates that as the grade level progresses, it influences the students' self-efficacy feelings towards using number sense strategies. It can be said that as mathematics education increases and subject knowledge enhances, it affects the students' self-efficacy in developing flexible solutions to problems and making practical calculations without using pen and paper. When examining the literature, it is observed that there are very few studies on number sense self-efficacy. Çaylı Suel (2019) considered number sense self-efficacy on a class basis in her study and concluded that as the class level increases, the average number sense self-efficacy also increases. Conversely, Yarar, Es, and Gürefe (2018) obtained the opposite result in their study, indicating that 5th-grade students have higher number sense self-efficacy than 7th-grade students. This study does not align with the findings of the current research.

When the numerical sense self-efficacy scores of students diagnosed with special talents were examined according to the gender variable, a significant difference in favor of male students was observed compared to female students. Besides demonstrating better number sense performance, it is notable that male students also had more advanced number sense self-efficacy. Aşkar and Umay (2001) mentioned that in the Turkish society, cultural perceptions, such as male students having more experience in daily life activities like trade and repairs, might be a reason for this outcome. Studies in the literature also indicate that there are no differences in number sense self-efficacy according to gender (Yarar, Es, and Gürefe, 2018; Çaylı Suel, 2019). This finding does not align with the results of the present research.

When examining the relationship between the scores of the number sense scale and the number sense self-efficacy scores of students diagnosed with special talents, a positive and significant relationship between the scores was found. It was observed that as the numerical sense scores of individuals in the study increased, their number sense self-efficacy scores also increased, or conversely, as the number sense scores decreased, so did the number sense self-efficacy scores. It can be said that the beliefs of students regarding problem-solving, understanding relationships between numbers and operations, and creative thinking affect their ability to use number sense strategies. Studies suggest that individuals with low self-efficacy are not persistent in seeking success (Deniz, 2017), self-efficacy is a predictor of success in mathematics (Chen and Zimmerman, 2007), and for students to persist in using numerical sense strategies, their self-efficacy needs to be high (Çaylı Suel, 2019), affirming this result.

Recommendations

Based on the current results, the following recommendations have been proposed:

- The reason behind students approaching problem-solving in rule-based methods is believed to stem from the predominant use of standard routine methods during class. Therefore, there should be an emphasis on using number sense strategies rather than rule-based approaches in solving problems during lessons.
- Exercises and activities in textbooks should be designed to enhance number sense.
- Guidelines aimed at enhancing number sense for teachers should be published, and seminars focusing on developing number sense in students should be conducted for mathematics teachers.
- Efforts should be made to raise awareness among teacher candidates about numerical sense, and there should be more emphasis on teaching number sense in courses to improve the expertise of teacher candidates in this area.
- This research was conducted with students diagnosed with special talents. There are few studies in the literature regarding the number sense performance of individuals diagnosed with special talents. Hence, future studies focusing on number sense should also consider this area.
- The research findings revealed a positive relationship between number sense and number sense self-efficacy. Detailed research should be conducted through interviews with students diagnosed with special talents to explore numerical sense self-efficacy further.
- As observed from the data obtained, having number sense self-efficacy also correlates with number sense success. Therefore, efforts should be made to raise awareness regarding number sense self-efficacy among students diagnosed with special talents to enhance their mathematical abilities.

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